STANDARDIZED ASSESSMENT IN MATHEMATICS: A QUALITATIVE EXPLORATION OF BLACK NOVA SCOTIAN PERSPECTIVES AND EXPERIENCES

by

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To every student who has felt overlooked in the education system and to every young person who believes their voice is unheard—this is for you.

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Abstract

Systemic challenges in the Nova Scotian education system for Black students, including the disproportionate placement on Individual Program Plans (IPPs), are well-documented. However, there is a dearth of research on how mathematics achievement assessments impact this population. The current study explored Black individuals' experiences and perspectives regarding mathematics assessment practices in the province. Semi-structured interviews were conducted with community members and staff from a local Africentric learning institute. Data were analyzed using reflective thematic analysis with culturally relevant pedagogy as the theoretical framework. Themes included negative experiences with math assessments, a one-size-fits-all approach, flawed assessment tools, and high-stakes testing. Participants also endorsed that math assessments lack cultural relevance for Black students. Pedagogical and assessment improvements included building students' math confidence to combat racialized narratives, incorporating Black culture and lived experiences, and including parents to teach children math. Implications for school psychologists and future research are discussed.

Keywords: mathematics, assessment, instruction, reflexive thematic analysis, Black students

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CHAPTER ONE

Literature Review

The Role of School Psychologists

School psychology is a specialized branch of professional psychology concerned with students, families, and the educational process. The most highly trained mental health practitioners within school settings (Sheridan & Gutkin, 2000), school psychologists provide indirect and direct psychological services at the individual, group, and system levels (King et al., 2016; National Association of School Psychologists [NASP], 2010). Specifically, school psychologists offer consultation, assessment, diagnosis, program development, prevention, and intervention strategies to support students' psychological, educational, and behavioural needs (Canadian Psychological Association [CPA], 2002; Saklofske et al., 2019).

School psychologists' primary role is to conduct psychoeducational assessments on students with academic, cognitive, emotional, social, or behavioural difficulties (Jordan et al., 2009; King et al., 2022; Saklofske et al., 2007). As such, a significant aspect of graduate-level training involves developing competency in assessment and evaluation. This includes learning to select test batteries based on referral questions (i.e., students' needs at school), administering standardized assessments, scoring tests, writing reports, and communicating assessment results (King et al., 2022; Lee et al., 2023).

Despite yearning for role diversification within the profession (King et al., 2022), little has changed in the past 15 years regarding school psychology practices. King et al. (2022) and Corkum et al. (2007) found that school psychologists in Nova Scotia, Canada, endorsed spending approximately half their time assessing and evaluating students. Research on current school psychological practices from other countries, including the United States, echoes these findings (McNamara et al., 2019). Thus, despite their vast training and numerous competencies, school

psychologists' enduring role is conducting psychoeducational assessments.

Standardized Cognitive and Academic Achievement Tests

As part of comprehensive psychoeducational assessments, school psychologists use standardized cognitive and academic achievement tests (Benson et al., 2019). Standardized or norm-referenced tests reflect how well a student performs compared to a large sample of individuals who are similar in age and developmental level (Lok et al., 2016). For example, if a student scores in the 60th percentile, they performed as well or better than 60 percent of children in the normative sample on that particular test. By analyzing the results of norm-referenced tests, school psychologists can identify which students are performing in the average (i.e., 16th - 84th percentile), above, or below average range in cognitive and academic domains.

Cognitive tests measure constructs such as general intelligence (also called *g*; Floyd et al., 2013), verbal and spatial abilities, memory and processing speed (Gutkin & Reynolds, 2009). Frequently administered cognitive tests in school settings include the Wechsler Intelligence Scale for Children (WISC-V; Wechsler, 2015), the Differential Ability Scales (DAS; Elliott, 2007), and the Woodcock-Johnson Tests of Cognitive Abilities (WJ-COG; Benson et al., 2019; Lockwood et al., 2022; Woodcock et al., 2001a). The Wechsler series continues to be school psychologists' most widely used cognitive assessment measure (Benson et al., 2019; Lockwood et al., 2022).

Standardized academic achievement tests examine academic knowledge or material taught in school, such as reading, writing, and mathematics (Sattler, 2001). Three commonly used general academic tests are the Wechsler Individual Achievement Test (WIAT; Wechsler, 2009), the Kaufman Test of Educational Achievement (KTEA; Kaufman & Kaufman, 2014), and the Woodcock-Johnson Tests of Achievement (WJ-ACH; Harrison et al., 2019; Woodcock et al., 2001b). The KeyMath-3 Diagnostic Assessment (KeyMath-3 DA; Connolly, 2008a) is an academic test used to measure mathematical abilities specifically.

The KeyMath-3 is an individually administered norm-referenced test that assesses mathematics achievement and identifies students' strengths and gaps in mathematical knowledge (Connolly, 2008a). It can be administered to students ages four to 21 and examines three general math areas—basic concepts (i.e., foundational knowledge), operations (i.e., computational skills), and applications (i.e., problem-solving abilities). The basic concepts section comprises five subtests: Numeration, Algebra, Geometry, Measurement, Data Analysis, and Probability. The operations section has three subtests: Mental Computation and Estimation, Addition and Subtraction, and Multiplication and Division. The applications section includes Foundations of Problem Solving and Applied Problem Solving (Connolly, 2008a).

Strengths and Challenges of Standardized Tests

Strengths

Assessments facilitate data collection and provide information to guide educationally relevant decisions for students (Benson et al., 2019; NASP, 2010). Specifically, assessing academic achievement is crucial for school psychologists and educators as it offers a snapshot of students' abilities and areas that require instructional attention in the classroom. If struggles are identified, support strategies and programming decisions can be made to help learners overcome academic challenges and reach their full potential at school. Moreover, these tests help identify academically gifted students (Lee et al., 2023), providing them with further opportunities and resources to excel. Assessments are also used for universal screening and academic progress monitoring within a multilevel system of support (Benson et al., 2019; Hendricker et al., 2023).

Standardized assessment tools play an essential role in identifying cognitive and academic challenges, which can lead to mental health diagnoses. One common disorder diagnosed using assessment data is a specific learning disorder or disability (SLD) (Fletcher & Miciak, 2019). By pinpointing learning difficulties and skill deficits, school psychologists and educators can design

specialized educational support services (Cartwright et al., 2017). They can also provide targeted evidence-based interventions to address students' academic needs, such as explicit phonics instruction for students with an SLD in reading (Fletcher & Miciak, 2019). In Canada, students diagnosed with an SLD may be eligible for provincial government funding (Kozey & Siegel, 2008). Furthermore, assessments are utilized to evaluate the effectiveness of evidence-based interventions and to monitor individual progress over time (Fagan & Wise, 2007).

Mathematics assessments serve several important purposes at the individual level. These assessments provide valuable insights into students' mathematical capabilities, revealing specific areas where they may need further support and highlighting gaps in their understanding of mathematical concepts (Bryant & Rivera, 1997). Similar to other academic assessment tools, the data gathered from mathematics test scores are instrumental in guiding targeted interventions for students experiencing difficulties in the subject (Fletcher & Miciak, 2019). Moreover, this information aids in planning and implementing remedial instruction for learners (Sessoms & Henson, 2018).

Challenges

While standardized tests offer several advantages, they also have significant limitations that warrant careful consideration. One enduring concern is the issue of validity. Validity refers to how accurately standardized assessments measure the constructs, skills, and attributes they purport to measure, for example, IQ or processing speed (Nellis & Hopple, 2016). Additionally, norm-referenced tests may not accurately reflect real-world achievement as they are conducted in a controlled testing environment. This lack of ecological validity should be considered when school psychologists interpret test results (Ebert & Scotta, 2014). A thorough understanding of these limitations is essential for ensuring that test results are analyzed in a meaningful way.

Although standardized tests inform diagnoses, traditional assessment approaches assume

within-person causes, which categorize individuals using a deficit-based model (Reschly & Tilly, 1999). Historically, this presumption has led practitioners and educators to attempt to identify and remedy the underlying causes of SLD rather than tailor instruction and intervention based on academic needs (Reschly & Tilly, 1999). Solely assessing to categorize or label students does not adequately inform intervention or improve student outcomes (Boneshefski, 2024). Acknowledging students' strengths is paramount and allows educators to leverage what students already know to increase their understanding of academic concepts.

Another issue with standardized assessment measures is an overreliance on cognitive test scores to predict academic achievement. IQ and academic achievement are not perfectly correlated. A high IQ does not indicate how well a student will perform academically, and vice versa. Sattler (2001) found that only 36% of students' success was attributable to their IQ, indicating that other factors play a crucial role in academic success. Some critics maintain that standardized intelligence tests fail to consider external factors, such as educational environment and family, which can significantly impact students' behaviour at school (Farrell, 2010). Since environmental factors influence behaviour, solely relying on numerical scores from assessments may overlook valuable qualitative data that could provide a more comprehensive picture of the student being assessed.

Cognitive and academic achievement tests are also prone to examiner scoring errors. Harrison and colleagues (2019) found that novice examiners were susceptible to making mistakes when scoring the WIAT-III. Other research has also shown that scoring errors can occur on cognitive tests (Cormier et al., 2019). This highlights a significant issue in test administration: the examiner's experience level can greatly impact the validity of the test outcomes. The effectiveness and usefulness of these assessment tools depend on proper administration and accurate scoring by trained professionals.

KeyMath-3-Diagnostic Assessment

Other challenges relate specifically to the KeyMath. One of the main concerns is how the KeyMath was developed. The content of the KeyMath-3-DA purportedly aligns with current national mathematics standards described by the National Council of Teachers of Mathematics (NCTM, 2000). Although the NCTM (2000) guidelines shape schools' mathematics programs (Connolly, 2008a), criticisms exist as to whether mathematics teachers and educators, as opposed to mathematicians, should be dictating how math is taught and assessed at school (Wu, 1997). The Canadian Edition of the KeyMath-3 also claims to align with provincial curriculum expectations (Connolly, 2008b). During pilot testing, its content was only reviewed by one independent reviewer (i.e., a mathematics educator; Connolly, 2008b).

There is a dearth of research on the reliability and validity of the KeyMath-3. Other than the standardization process for the U.S. and Canadian editions, only one study exists regarding the psychometric properties of the KeyMath-3. Kim and colleagues (2015) examined three subtests (i.e., Numeration, Geometry, and Measurement) that comprise what these authors called foundational Basic Concepts. The analysis revealed that this subscale was unidimensional, indicating that these three subtests can generally assess students' knowledge of foundational mathematical concepts (Kim et al., 2015). Despite this finding, problems arose when subtest items were further analyzed. Some misfitting items (i.e., participants answered correctly to items above their ability levels) were found (Kim et al., 2015).

Additionally, the analysis revealed inconsistencies in the ordering of questions by difficulty level. More difficult items frequently came before easier items, indicating that students were not always answering easier questions before answering harder ones (Kim et al., 2015). This particularly impacts students with lower mathematics abilities as they may discontinue earlier than warranted, which may not accurately reflect their proficiency in math (Kim et al., 2015). The

sequence of questions may suggest the assumption that learning mathematics follows a hierarchical structure. In this view, math concepts and knowledge build upon one another, making earlier knowledge essential for grasping subsequent topics. However, many theorists argue that mathematics is better understood as a network of interconnected ideas rather than a strict hierarchy (e.g., Cobb & Yackel, 1998; Skemp, 1976), which is not reflected in the KeyMath-3.

Another problem with the KeyMath relates to scoring. Like other standardized assessment measures, the KeyMath-3 does not award points for partial answers (Connolly, 2008a, 2008b). This all-or-nothing approach, where answers receive either a point or none, does not effectively measure a student's understanding, partial problem-solving skills, or mathematical thinking. Additionally, some test items consist of two parts, A and B. If a student answers part A correctly, the administrator can present part B; however, the KeyMath manual lacks clear guidelines on scoring these additional parts (Rosli, 2011). As a result, students' math abilities might be underestimated if they are not given the chance to answer these extra questions.

An additional issue with the KeyMath-3 relates to its linguistic structure. Some of the questions are phrased in a manner that is ambiguous and vague, which can create confusion among students. This may lead to varied interpretations of the questions, potentially causing students to answer incorrectly despite having a solid understanding of the underlying concepts and demonstrating sound reasoning. As a result, the effectiveness of the assessment in accurately reflecting a student's mathematical abilities may be compromised.

Black Students and Standardized Assessments

Despite the utility of standardized assessments, they are not without criticism, particularly regarding their impact on minority populations. Beyond the previously mentioned concerns, there are additional issues when these tests are administered to Black individuals. The following section highlights the current and historical challenges associated with using cognitive and academic

achievement tests for Black students.

Cognitive Tests

Since their inception, there has been an ongoing debate about administering cognitive tests to Black individuals. Fagan and Wise (2007) posited that "Traditional definitions of intelligence may in reality be more closely related to a person's ability to function within a predominantly white, middle-class, public school system than to any innate general cognitive ability" (p. 113-14). Thus, what is measured by cognitive tests may not reflect the intellectual abilities of Black students but rather their acculturation to European hegemony. Indeed, a recent study showed that 54.3% of school psychologists endorsed that current IQ tests contain culturally biased concepts and language, which they believed affected Black students' performance (Aston & Brown, 2021).

Throughout history, cognitive assessment instruments evolved alongside racial beliefs about Black Americans. Low cognitive test scores were used to justify eugenics movements and evidence of the white supremacist notion that Black people were intellectually and culturally inferior (Herrnstein & Murray, 1994; Ladson-Billings, 1999). From the 17th century to the first half of the 20th century, many scholars endorsed the existence of racial hierarchies (Herrnstein & Murray, 1994; Jensen, 1969; Montagu, 1997), which they claimed were reinforced by scientific theories (e.g., IQ testing) comparing test performance of Black and white examinees (Ladson-Billings, 1999). Over the years, pervasive beliefs about innate differences in intelligence and racial stereotypes formed the inequitable foundation of using cognitive assessments on Black populations. This occurred despite warnings from test authors that these measures were not valid for Black or culturally diverse examinees (Guthrie, 2004).

The first measures of general intelligence, the Stanford-Binet (1916) and Weschler-Bellevue (1939) IQ tests, failed to include Black individuals in the standardization samples (Guthrie, 2004). When the Binet scale was revised in 1937 and 1960, test authors deliberately

excluded Black students and other students of colour from the sample, including only white children (Terman & Merrill, 1937, 1973). The choice not to include Black children in the standardization group resulted in six decades of racially diverse children being administered tests despite not being represented in the sample to which they were compared (Graves & Aston, 2016). This remains a major criticism about the Stanford-Binet Scale (Valencia & Suzuki, 2001), yet this is the tip of the iceberg surrounding inequitable practices in cognitive assessment measures for Black individuals throughout history.

Another issue is the factorial validity, or factor structure, of cognitive tests for Black students. Factorial validity is a form of construct validity, which is the degree to which a test measures the theoretical construct (e.g., cognitive abilities) it purports to measure. Factorial validity refers to the internal structure of a test and how test items are related to each other. Examining the factorial validity of a test is essential in determining whether test items match the test's theoretical structure. A study by Graves et al. (2021) examined the validity of the most recent iteration of the Weschler series, the WISC-V, on a sample of Black students referred for special education services. Researchers found that a four-factor model fit the data better than the five-factor solution proposed by test developers. Thus, test items clustered into four groups, as opposed to five, when measured with this population. The actual (i.e., empirical) structure of the assessment did not match the theoretical (i.e., intended) structure of the test. This finding suggests that the factorial validity of the WISC-V is in question when used to assess Black students' cognitive abilities.

Graves and colleagues (2021) also found that two subtests of the WISC-V—picture span and figure weights—were not invariant by race, meaning that these measures operate differently for Black students than white students. Items that function differently by race reduce the validity of the assessment tool as they may not differentiate between specific traits (i.e., fluid reasoning and

working memory) and socialization and learning opportunities (Graves et al., 2021). Other research has found similar results using standardization samples from test publishers. For example, Kush et al. (2001) examined the factor structure of WISC-III using the standardization sample and a school-based referral sample of students. They found anomalies with the third and fourth factors, especially with the referred Black sample. More research using non-standardization samples is needed to enhance our understanding of cognitive assessment instruments with Black children (Graves et al., 2021).

The seminal case of *Larry P. v. Riles* (1979) led a judge to ban the use of IQ tests on Black students in California (Hilliard, 1983). The ruling judge, Robert Peckham, contended that intelligence tests were racially and culturally biased and discriminatory against Black individuals (Guthrie, 2004). To this day, school psychologists in California cannot use standardized intelligence tests to determine placement in special education for Black students (Graves & Aston, 2016). Despite this and other rulings, many states continue to use intelligence tests on Black populations to make placement decisions (Graves & Aston, 2016).

Academic Achievement Tests

There is a paucity of research assessing the academic achievement of culturally diverse learners. One concern about standardized academic achievement measures is that they fail to account for cultural differences in students' knowledge. Factors other than academic skills, such as language and culture, are measured, to some degree, by most standardized assessments (Pitoniak et al., 2009). According to Rhodes et al. (2005), differences in cultural knowledge are "one of the most influential factors operating within the context of any evaluation" (p. 136). Moreover, normative samples often do not represent the student's cultural diversity (Rhodes et al., 2005). Consequently, it has been suggested that test results should not be considered valid if a student's cultural background vastly differs from the standardization group (Flanagan et al., 2013; Sattler,

2008).

The Culture-Language Interpretive Matrix (C-LIM) (Flanagan et al., 2013) was developed to determine the impact of cultural and linguistic factors on students' performance on cognitive tests. If subtests on standardized cognitive assessments have high cultural and linguistic loadings according to the C-LIM, then performance likely reflects experiential differences between the student and the normative sample. Consequently, such results are considered invalid and uninterpretable (Flanagan et al., 2013). Academic achievement subtests have not been examined using the C-LIM, although authors suggest cultural loadings would be high across academic assessment measures (Flanagan et al., 2013). Thus, performance on academic assessments may primarily reflect students' knowledge of the dominant culture instead of accurately assessing academic skills.

The lack of diversity in standardization samples is still apparent in current academic achievement assessments. The Canadian Edition of the most recent iteration of the KeyMath (Connolly, 2008b) ostensibly continues the persistent trend of underrepresenting Black students in the normative sample. In contrast to the U.S. sample, descriptions of the characteristics of the Canadian standardization sample for the KeyMath-3 are nonexistent. Other than noting that the sample was selected based on 2006 Canadian Census data, no mention of racial or ethnic backgrounds is reported in the manual (Connolly, 2008b). One has to wonder if this lack of transparency (to this day) has anything to do with a racially monolithic sample. More research on the KeyMath-3, particularly the Canadian edition, must be undertaken to examine its validity across diverse populations. Furthermore, the current landscape reveals a significant gap: no culturally relevant standardized mathematics assessments exist. This highlights the pressing need for research aimed at developing assessments that accurately reflect and honour the diversity of student populations.

Dynamic Assessment

Dynamic assessment (DA) offers a more equitable alternative to standardized assessments by focusing on a child's learning potential rather than just their acquired knowledge. Unlike traditional standardized tests, which compare a child's performance against a normative sample, DA emphasizes how a child learns and identifies the areas where they require support (Lauchlan & Daly, 2023). Characterized by an interactive approach, DA incorporates prompting, teaching, and immediate feedback during the assessment, allowing for real-time assistance (Grigorenko & Sternberg, 1998; Poehner, 2008). One of the initial goals of DA was to show that relying on static intelligence or achievement tests can lead to the inaccurate placement of children in special education, even if they have high learning potential (Haywood & Lidz, 2007). This issue was particularly prevalent among equity-deserving groups whose poor test performance often reflected cultural differences rather than learning difficulties (Feuerstein et al., 1979). Therefore, DA may help reduce the biases present in traditional assessments, making it a more suitable option for students who have historically faced challenges with these methods. Unfortunately, DA approaches are seldom recognized or used by clinicians and school psychologists in North America, while they are more prevalent in the United Kingdom.

The Achievement/Opportunity Gap

The absence of culturally relevant and valid assessment tools for diverse student populations has many adverse effects on these equity-deserving groups. One significant challenge of assessment inequities is the achievement gap (Ladson-Billings, 1994, 1995, 1997; Tate, 1995). The achievement gap refers to enduring differences in academic achievement observed between minority groups, such as Black, Latinx, First Nations, and English language learners, and their middle-class white peers (Gutiérrez, 2008). In the United States, Black students consistently score lower on standardized tests than their white counterparts (Downey & Pribesh, 2004; Ladson-

Billings, 2006a; Leonard, 2018). This is concerning as standardized test scores inform educational placement decisions (Graves et al., 2014). As a result, Black students are disproportionately overrepresented in special education programs (Connor, 2017; Graves & Mitchell, 2011; Morgan et al., 2017) and underrepresented in gifted programs in the U.S. (Aston & Brown, 2021).

The achievement gap has long been used to describe the difference in academic performance between Black and white students. This term, however, fails to acknowledge systemic inequities in educational opportunities for Black populations (Ladson-Billings, 1997). The achievement gap is deficit-oriented and falsely ascribes achievement discrepancies to ethnicity and race. Yet, race, ethnicity, and socioeconomic status do not cause academic failure (Gay, 2010). The achievement patterns of certain ethnic and racial groups cannot be attributed to performance without examining the conditions that led to those outcomes (Gay, 2010; Ladson-Billings, 2006a). The opportunity gap[1] is a more accurate term, as it highlights Black students' historic and current educational disparities (Flores, 2007). Indeed, Ladson-Billings (2006a) refers to the achievement gap as the educational debt, underscoring the institutional inequities Black students encounter at school.

Educational Inequities for Black Students in Canada

In 2021, Canada's Black population reached over 1.5 million, representing 4.3% of the country's residents (Statistics Canada, 2024a). According to population projections, the Black population is expected to reach more than 3.0 million by 2041 (Statistics Canada, 2022). Children under 15 years old account for 26.1% of the Black population, representing 16.5% of the total population in this country (Statistics Canada, 2024b).

Black students in Canadian schools experience educational inequities, such as racism,

[1] I prefer to refer to the achievement gap as the opportunity gap to better reflect systemic inequities encountered by Black students; however, I use achievement gap if that is the term used in the empirical literature.

discrimination, and differential treatment. In 2017, the United Nations Human Rights Council identified anti-Black structural racism in many Canadian institutions, including the education system. A review of the Peel District School Board in Ontario revealed that students, parents, and educators acknowledged the presence of anti-Black racism in schools (Chadha et al., 2020). This included derogatory comments and behaviours from both students and staff, such as the use of the N-word, instances of microaggressions, and teachers' failure to address racist behaviour when they witnessed it (Chadha et al., 2020). Older research also found that racism is a significant barrier to academic success for academically gifted Black students in Alberta's secondary schools (Codjoe, 2001). Referring to institutional racism as the "Public Enemy" (p. 343) in education, Codjoe (2001) argued that to address the underachievement of Black students, racism in the school climate must first be tackled.

Discriminatory actions manifest as disproportionate disciplinary practices and low teacher expectations. Black students in Canadian schools believe they are more likely to be disciplined, suspended, and face police presence compared to their white peers (Ruck & Wortley, 2002). These findings align with earlier studies (Solomon, 1992) and highlight ongoing issues that have persisted over time. An analysis of data from the Toronto District School Board found that between 2006 and 2011, Black students were more than twice as likely as their white counterparts to be suspended (James & Turner, 2017). By the time they graduated, 42% of Black students had been suspended at least once, compared to 18% of white students (James & Turner, 2017). Data also revealed that Black students are disproportionately expelled from school. During a five-year period from 2011-2012 to 2015-2016, 48% of the 213 students expelled were Black, compared to only 10% of white students (James & Turner, 2017).

Teacher expectations are beliefs that teachers hold about the academic abilities of students of different ethnicities and cultural backgrounds (Peterson et al., 2016). A recent Canadian study

showed that teachers held lower academic expectations for racially marginalized students than for white students (Flanagan et al., 2020). This is concerning as evidence suggests that teachers' negative expectations could bias their evaluations and predict student academic performance (Jussim & Harber, 2005). This may partially explain why Black students experience lower educational attainment, higher dropout rates, and streaming into more general or basic-level academic programs rather than advanced-level ones (James & Turner, 2017; United Nations, 2017). Streaming is an enduring concern in Black communities. A news article by Maynard (2017) indicated that "Black youth continue to be disproportionately streamed into lower education tracks as a result of both individual prejudice and systemic factors. Racial stereotypes held by teachers play a significant role in the streaming of Black students." Consequently, the achievement gap cannot be rectified until subpar instruction, low teacher expectations, and disproportionate disciplinary practices are resolved (Lewis & Hunt, 2019).

The Black Population in Nova Scotia

The deep-rooted history of Black Nova Scotians spans over 400 years in this province. Black communities, including Black Loyalists, Jamaican Maroons, and Black Refugees, settled across the province in areas such as Preston, Hammonds Plains, Beechville, and Halifax (Sadlier et al., 2018). Today, Nova Scotia's Black population consists of diverse descendants that form 52 unique communities in African Canadian society (Sadlier et al., 2018).

Educational Inequities for Black Students in Nova Scotia

As of November 2023, 8% of the student population in Nova Scotia self-identified as having African Heritage (Nova Scotia Department of Education and Early Childhood Development [NS DEECD], 2023). Approximately 7,700 Black students are enrolled in public school systems across the province (NS DEECD, 2022). Systemic and institutional inequities endured by Nova Scotia's Black population reflect those found in other Canadian schools. Although viewed as a

historical occurrence, Black Nova Scotian youth continue to face barriers in their education, including racism and discriminatory practices, as discussed below.

The BLAC Report on Education

In 1990, the government of Nova Scotia appointed the Black Learners Advisory Committee to conduct a comprehensive review of the education system to help resolve unequal access to quality education for Black learners. The committee, composed of 12 members from the Black community with diverse backgrounds, compiled a report in 1994 known as the BLAC Report. This extensive document highlighted how racism manifests in the education system, its impact on Black students and the community, and recommendations to address systemic racism in Nova Scotian schools (Black Learners Advisory Committee [BLAC], 1994).

Interviews with parents, students, community leaders, teachers, and administration elucidated the realities faced by Black learners in the early 1990s (BLAC, 1994). Racism and its manifestations, including name-calling, racial slurs, stereotyping, and differential treatment, were identified as the main issues for Black students in schools. Black students reported experiencing indifference, cultural insensitivity, and low academic expectations from teachers. The absence of Black history and culturally relevant content in the curriculum, along with ineffective teaching methods rooted in Eurocentric tradition and racism, were also emphasized. These factors impacted the self-esteem and motivation of Black students and contributed to the sense of isolation experienced in schools with few positive Black role models (BLAC, 1994).

Streaming Black students into non-academic, less challenging courses was another common practice at the time of the publication of the BLAC (1994) report. Black students were disproportionately referred to special education programs for academic and behavioural difficulties. This was a frequent occurrence regardless of aptitude and academic ability. Guidance counsellors dissuaded Black students from taking advanced mathematics and science courses, steering them

toward vocational and general programs. This practice effectively pushed Black students out of careers in engineering, business, and medicine. Labelling Black students as 'slow' and streaming them into low-ability classes was detrimental to future endeavours, as "once a child is in a low track, it is almost impossible to get out" (BLAC, 1994, p. 44). Moreover, some parents did not have the advantage of understanding the consequences of placement decisions or possess the skills to negotiate these decisions, leaving their children without advocates in a racist system.

The report contained 46 detailed recommendations to address racism in the education system (BLAC, 1994). Recommendations included establishing an Africentric institute for research and education, addressing the underrepresentation of Black teachers and administrators by hiring more Black staff members in education, providing students with Black role models and support workers, implementing anti-racism training and policies in all areas of the education system, including pre-service training, and developing learning and teaching materials that represent Black culture, history, and tradition (BLAC, 1994). Further suggestions included providing scholarships and financial support to Black learners to pursue higher education, involving Black parents and the community in their children's education, and working with the community to resolve discipline problems (BLAC, 1994).

The BLAC Report on Education Today

A report published by the Nova Scotia Department of Education (2003) outlined what recommendations have come to fruition since the BLAC report's publication in 1994. An Africentric institute for research and education was established—the Delmore "Buddy" Daye Learning Institute (DBDLI) in 2012; scholarships and funding assistance programs for Black students were created; anti-racist policies and teacher training modules on race relations became mandatory; resources and learning materials on Black history, tradition, and culture were developed (e.g., African Heritage Literature 12; Nova Scotia Department of Education, 2003). This

report concluded that while some recommendations have yet to be implemented, for example, increasing the number of Black educators, substantial progress has been made in addressing the racial equity issues outlined in the BLAC (1994) report.

Despite these advancements, racism still "permeates the entire social, economic, political and cultural environment of Nova Scotia and Canada." (BLAC, 1994, p. 34) Students frequently report that their teachers do not understand Black Nova Scotian culture, nor do they possess adequate training in race relations and Black history (African Nova Scotian Affairs, 2017; Halifax Regional School Board, 2003; Hamilton-Hinch et al., 2017; Smith et al., 2005; United Nations, 2014). Black students experience discriminatory practices such as low teacher expectations, stereotyping, and lack of culturally relevant curriculum (African Nova Scotian Affairs, 2017; BLAC, 1994; Dei, 2008; Hamilton-Hinch et al., 2017; Smith et al., 2005; United Nations, 2014). They are also suspended at higher rates than other students in the province. An analysis by CBC News of data from five school boards found that Black youth experience out-of-school suspensions at rates 1.2 to three times higher than their representation among the overall student body in Nova Scotia (Woodbury, 2016). According to education advocates, factors behind these disproportionate suspension rates include a shortage of Black teachers, a curriculum that lacks Africentricity, and cultural misunderstandings between teachers and students (Woodbury, 2016). Thus, it seems little has changed since Codjoe (2001) noted, "Black educational theory and practice have not been a priority in mainstream Canadian education" (p. 345).

Individual Program Plans and Disproportionality

Mirroring the BLAC (1994) report's findings, Black students continue to be streamed into non-academic and low-level courses (Chadha et al., 2020; United Nations, 2017). Currently, this discrimination manifests in the overrepresentation of Black students being placed on Individual Program Plans (IPPs) in Nova Scotia (NS DEECD, 2016). An IPP is "developed for a student who

cannot meet the curriculum outcomes of the public school program, or for whom the outcomes do not apply. The IPP replaces some or all of the outcomes from the public school program with individualized outcomes" (NS DEECD, 2016, p. 3). Thus, students on IPPs do not follow regular classroom curricula but learn specialized curricula based on their strengths, interests, and challenges. A student can be on an IPP for one subject, such as mathematics, or multiple subjects, such as mathematics and English Language Arts. IPPs are developed by the school's program planning team, which comprises parents or guardians, teachers and other school staff, and administration. School psychologists are occasionally involved, sharing results from academic standardized tests and recommending the best ways to support the student. For IPPs to be effective, monitoring students' academic progress, conducting semi-annual reviews with program planning teams, and updating IPP outcomes is imperative.

Black students in Nova Scotia are disproportionately overrepresented on IPPs[2], with little changing since the publication of the BLAC (1994) report 30 years ago (NS DEECD, 2016). In 2016, the Nova Scotia government reviewed IPP data on TIENET province-wide. TIENET, which stands for Technology for Improving Education Network, is a web-based platform that documents and manages student information, including IPP data. Findings from the province's school boards revealed a disproportionately high number of IPPs for students self-identifying as Black Nova Scotians (NS DEECD, 2016). Black students were 1.5 times more likely to have an IPP in at least one subject area than non-Black students. The percentage of non-Black students with an IPP was 5.4%, compared to 7.9% of Black students with an IPP (NS DEECD, 2016). When evaluating the IPPs for Black students, only 66% of the programming plans were deemed by the review panel as the most suitable option for students' learning and social needs (NS DEECD, 2016). This means that 34% of Black learners placed on IPPs could have benefited from other educational or

[2] These are called individual education plans (IEPs) in other parts of the country.

behavioural modifications (e.g., extended testing time, use of a scribe, behaviour plan) instead of an IPP.

Considering the history of racist practices within the education system, Black parents must be part of the student's program planning team throughout the IPP process (NS DEECD, 2016). A preliminary search of provincial documents provided little information for parents about the impact and future implications of their child being placed on an IPP. Consequently, some parents are unaware of the ramifications of IPPs, which can prevent them from making fully informed decisions about their children's education. Parents should be explicitly told that IPPs can prevent students from enrolling in certain academic courses, which can hinder eligibility for scholarships and funding and limit future educational opportunities and career choices. Knowledge about IPPs and advocating for children in the school system is just as important for Black parents today as it was in 1994.

The IPP review highlighted the disproportionate barriers Black students face in school (NS DEECD, 2016). In June 2021, a news release from the Premier's office emphasized the need to address these systemic barriers (Government of Nova Scotia, 2021). The then Premier Ian Rankin stated that tackling this issue was crucial for the province's social fabric and economic future. As a result, Nova Scotia implemented ongoing equity assessments, which include annual audits of IPPs. These assessments will be used to make recommendations to address educational inequities and promote accountability and anti-racism initiatives within the education system (Office of Equity and Anti-Racism Initiatives, 2022). In April 2022, Nova Scotia passed legislation addressing systemic hate, racism, and inequity in government policies and programs, called The Dismantling Racism and Hate Act (the Act; Office of Equity and Anti-Racism, 2023). Informed by community engagement, the Act is the first in Canada, and demonstrates the government's commitment to acknowledging the needs of underrepresented and underserved communities across the province

(Office of Equity and Anti-Racism, 2023).

Culturally Relevant Pedagogy

In line with the BLAC report's (1994) recommendations, culturally relevant pedagogy (CRP) has been identified as a way to narrow the achievement gap for Black students (Dickson et al., 2015; Hammond, 2015; Ladson-Billings, 1994; Sleeter, 2012). Ladson-Billings (1995a) used the term culturally relevant pedagogy (CRP) to describe the instructional practices of eight teachers who successfully taught Black students in the late 1980s and early 1990s. Culturally relevant pedagogy "empowers students intellectually, socially, emotionally, and politically by using cultural referents to impart knowledge, skills, and attitudes" (Ladson-Billings, 1994, pp. 17-18). It is a pedagogy of opposition committed to collective, rather than individual, empowerment (Ladson-Billings, 1994).

CRP focuses on building three tenants: academic achievement (i.e., intellectual growth as a result of learning), cultural competence (i.e. appreciation and celebration of one's own and other cultures), and critical consciousness (i.e., expanding classroom knowledge to critique and solve real-world problems) by incorporating Black students' cultural backgrounds in the classroom (Ladson-Billings, 1995a). As such, students are encouraged to excel academically, embrace their cultural identity, and recognize and challenge current social inequities (Ladson-Billings, 1995a). This approach opposes the deficit-oriented view about children of colour by seeing all students as capable of academic excellence and positive outcomes (Adams & Glass, 2018). CRP also emphasizes building dynamic and synergistic relationships between home, community, and school and encourages teachers to engage with students in respectful, empathetic, and culturally responsive ways (Ladson-Billings, 1995a).

Building on Ladson-Billings' work, Gay (2010) used the term culturally responsive teaching (CRT), which she defined as "the use of cultural knowledge, prior experiences, frames of reference,

and performance styles of ethnically diverse students to make learning encounters more relevant to, and effective for, them" (p. 31). This framework emphasizes instructional techniques that aim to enhance educators' competencies and methods in the classroom. Gay (2002) emphasized connecting academic material to students' lived experiences and leveraging their cultural knowledge to improve academic achievement. Culture should be valued and affirmed at school and used as a springboard to teach new concepts, called cultural scaffolding (Gay, 2002). Cultural scaffolding is "using [students'] own cultures and experiences to expand their intellectual horizons and academic achievement" (Gay, 2002, p.109).

CRP and CRT share a fundamental goal of promoting the inclusion of culturally, racially, and ethnically diverse groups in educational curricula and pedagogy. Despite this, these approaches have nuanced differences. Although CRP and CRT are often used interchangeably, it is crucial to differentiate between them. Gay (2010) emphasized the doing aspect, which refers to the teaching methods and practices educators should adopt to be culturally responsive. In contrast, Ladson-Billings (1994, 1995a) focused on pedagogy, which involves shaping educators' attitudes and dispositions. When implemented effectively, this focus on pedagogy can influence planning, instruction, and assessment (Aronson & Laughter, 2016). Thus, while CRP and CRT address two distinct yet complementary outcomes—teaching enhances competence, whereas pedagogy influences attitudes—Ladson-Billings (2006b) argues that CRP is fundamentally about a way of being rather than just an act of doing. Both approaches are powerful in their own right, but the current paper primarily focuses on Ladson-Billings' (1995a) concept of CRP.

Culturally Relevant Pedagogy in the Classroom

Ladson-Billings (1994, 1995a) provided examples of how teachers displayed the three tenets of CRP in the classroom. Regarding academic success, teachers employing culturally relevant practices believe all students are capable of academic excellence and expect success from

Black students. These beliefs permeate all aspects of their classrooms (Ladson-Billings, 1994). For instance, one teacher started each morning by asking her students, "What are we going to be our best at today?" She welcomed both academic (e.g., “I’m gonna be good at my math”) and non-academic (e.g., “I’m gonna be good at lining up for recess”) goals they wanted to excel in (Ladson-Billings, 1994, p. 48). At the end of the day, she congratulated the students on their achievements. Another teacher tapped into students' strengths and skills by incorporating diverse projects and assignments that enabled them to demonstrate their knowledge beyond conventional tests. For instance, if a student displayed a talent for sewing, she leveraged this strength to teach reading and writing by integrating relevant texts and written tasks about the subject (Ladson-Billings, 1994).

These teachers also encouraged collaborative and reciprocal learning, understanding that knowledge is not passed unidirectionally from teacher to student. They viewed teaching as a process of extracting existing knowledge from their students, similar to mining. Students were considered experts in certain areas, with valuable information to share with educators (Ladson-Billings, 1994). Exemplifying this belief, one teacher took time to speak to parents to learn about what they had taught their children. Additionally, this teacher talked to her students to understand their interests and areas of expertise. This information allowed her to incorporate students’ prior knowledge into the learning process and help them make relevant academic connections (Ladson-Billings, 1995a).

Teachers also promoted cultural competence and critical consciousness in their students by using culturally relevant teaching methods (Ladson-Billings, 1995a). To increase cultural pride, one teacher used rap song lyrics to teach her students about poetry, inspiring them to create their own songs. Another teacher redirected a student experiencing behavioural problems to channel his leadership abilities into a positive outlet. She encouraged him to run for sixth-grade president, rallying the class to support his campaign. Another teacher supported critical consciousness by

collaborating with her students to identify underused community spaces, explore previously inaccessible historical records, propose alternative uses for an empty shopping mall, and write and present urban planning proposals to the city council. These dedicated educators effectively supported their Black students' learning by integrating rigorous academic standards with cultural competence and sociopolitical awareness (Ladson-Billings, 1995a).

Research on CRP with Black Students

A study by Howard (2001) assessed Black elementary students' perceptions of culturally relevant teaching practices in urban elementary schools. Three central themes emerged from interviews with students: the importance of caring teachers with high expectations, the establishment of family and community-type classroom environments (i.e., making school seem like home), and education as entertainment (Howard, 2001). Although fewer students noted the latter theme, those who did insisted that they learned better and were more engaged when teachers made learning fun and exciting. Across themes, students' accounts indicated that culturally relevant practices displayed by their teachers positively impacted their effort, engagement, and academic achievement (Howard, 2001).

Another study highlighted a three-year intervention program, the UCLA Sunnyside GEAR UP program (Gaining Early Awareness and Readiness for Undergraduate Programs), designed to improve educational outcomes for Black students (Howard & Terry, 2011). The GEAR UP program used culturally relevant practices to provide intensive academic support (e.g., in-class and after-school tutoring, study skills training, SAT prep) to students at a local high school (Howard & Terry, 2011). Culturally relevant pedagogy was exhibited through instructional practices, teacher-student relationships, and an emphasis on academic rigour. As a result, this school celebrated the largest graduating class in a decade. Moreover, 60 Black students were accepted to four-year colleges—two times more than the previous year—and nine Black students were accepted to

UCLA, one of the more difficult colleges to gain admission (Howard & Terry, 2011). This project demonstrated that culturally responsive teaching directly impacts student learning and engagement, increasing Black students' college readiness and acceptance rates (Howard & Terry, 2011).

A quantitative study assessed the impact of culturally relevant teaching by examining student perceptions of these practices. The sample was racially diverse (25% White, 25% Latino, 25% Black, and 25% Asian) and consisted of students in grades six through 12 in U.S. schools (Byrd, 2016). The study found that aspects of culturally relevant teaching, such as connecting lessons to students' lives and promoting understanding of various cultures, were linked to increased interest in school and improved academic performance. These practices were also positively related to ethnic-racial identity development (Byrd, 2016). Promoting cultural competence was also associated with greater feelings of belonging at school (Byrd, 2016). Overall, this study supported the effectiveness of culturally relevant teaching in enhancing academic performance and fostering positive racial and cultural identities for diverse learners.

Some contend that CRP simply reflects "good teaching" (Adams & Glass, 2018; Ladson-Billings, 1995b, p. 159). Yet, the importance of integrating race and culture into the classroom cannot be ignored. While the principles of culturally responsive pedagogy align with general best practices in education, such as student engagement, high expectations, and differentiated instruction, effective teaching for Black students necessitates culturally responsive practices. This perspective suggests that CRP is not just a separate or additional approach but an essential component of high-quality education for all students (Ladson-Billings, 1995a).

Culturally Relevant Pedagogy in Provincial Education Documents

Numerous provincial documents underscore the importance of culturally relevant pedagogy for diverse learners. In September 2020, educational institutions in Nova Scotia committed to implementing a new Inclusive Education Policy (Whitley & Hollweck, 2020). Similar to other

provinces in Canada, inclusive education now encompasses not only students with disabilities but also students from historically marginalized populations, including Black Nova Scotians, Mi'kmaw communities, and students growing up in poverty (NS DEECD, 2019a). As such, the Nova Scotia Inclusive Education Policy document references culturally and linguistically responsive instruction. Guideline 4.1 states, "Every student can learn with enough time, practice and equitable and responsive teaching," and guideline 4.6 notes, "Inclusive education is a commitment to honour and respect each student's cultural and linguistic identities and knowledge systems" (NS DEECD, 2019a, p. 2).

Nova Scotia's current educational framework is a Multi-Tiered System of Support (MTSS). It reflects the guiding principles of the Inclusive Education Policy (NS DEECD, 2019a). This framework was designed to provide an integrated, school-wide approach to meet all students' diverse academic, social-emotional, and behavioural needs, supporting equitable student well-being and achievement (NS DEECD, 2019b). It emphasizes culturally responsive instruction, assessment, and intervention across three tiers with varying levels of support—universal, focused, and intensive. Collaboration between students, families, teachers, and community partners is essential in ensuring students receive the proper support and services (NS DEECD, 2019b).

Another provincial document that mentions culturally responsive teaching practices is the Individual Program Plan (IPP) review from the Nova Scotia Department of Education and Early Childhood Development. The review states, "All students are entitled to differentiated instruction and culturally responsive teaching to help them achieve [educational] outcomes" (NS DEECD, 2016, p. 3). It was suggested that if curriculum and instruction were more "relevant and innovative" (NS DEECD, 2016, p. 1) and better aligned with students' unique learning needs and experiences, fewer students would need to be placed on IPPs. Thus, it is incumbent on educators to include differentiated instruction and culturally responsive teaching practices in their classrooms. It

is also crucial that when designing, implementing, and monitoring IPPs, the program planning team collaborates to ensure each student's racial and cultural identity, strengths, challenges and interests are adequately represented (NS DEECD, 2016).

African Nova Scotian Education Framework.

In 2019, an education framework was created to promote the well-being and success of Black learners in Nova Scotian schools (NS DEECD, 2021). The *African Nova Scotian Educational Framework* aligns with the principles of equitable education outlined in the BLAC (1994) report. It reflects the commitment to providing high-quality, culturally and linguistically responsive education as stated in Nova Scotia's Inclusive Education policy (NS DEECD, 2019a). This framework was informed by the experiences of students, parents, educators, and the Council on African Canadian Education (NS DEECD, 2021).

The framework is composed of five pillars. Each pillar represents essential themes for Black students to feel secure and supported in the provincial education system, enabling them to reach their full potential (NS DEECD, 2021). The pillars include authentic self-identification (i.e., valuing identities, cultural assets, and ways of being), knowing them as they are known (i.e., strengths-based practices that honour spiritual, family, and community beliefs), educational programming and services (i.e., academic and wellness programs, services, and supports from pre-primary to graduation), empowering students and families (i.e., the collaboration between home, school and community), and equitable access and involvement (i.e., increasing access to resources and involvement in decisions that support Black students, parents, and staff).

These provincial documents highlight the importance of equity practices in addressing Black learners' systematic barriers to education. Inclusive education and culturally relevant practices should permeate all facets of Black students' schooling experiences to ensure positive social, behavioural, and academic outcomes. This includes how mathematics is taught and assessed

in schools. The following section outlines the importance of mathematics instruction, how mathematics is traditionally taught, and more culturally relevant ways in which mathematics could be taught to Black students. Black math success stories are also highlighted.

Mathematics Education

A significant portion of students' academic careers is devoted to learning mathematics. Mathematics is a crucial life skill that can open or close doors for students. It is a gateway to higher education and career opportunities (Gutstein, 2003; Martin, 2000). Many STEM (i.e., Science, Technology, Engineering, and Mathematics) fields require a solid foundation in mathematics. Math proficiency also has practical applications in daily life, such as managing finances, cooking, and planning travel. Learning mathematics enhances logical reasoning and analytical skills. Furthermore, it equips students with critical thinking abilities to question societal structures and injustices (Gutstein, 2003, 2006). For example, interpreting and analyzing statistics in reports and government policies requires mathematical literacy.

There is ample evidence of the importance of math education and instruction. According to the world's largest organization of math educators, the National Council of Teachers of Mathematics (NCTM), a solid foundation of mathematical knowledge is essential for future learning (NCTM, 2000). Moreover, the early acquisition of basic math skills (i.e., number sense, arithmetic facts, and computational procedures) impacts subsequent academic outcomes (NCTM, 2000). Mathematical knowledge is essential for comprehending the concepts taught in many other academic subjects, including science, social studies, music, and art.

Mathematics Education for Black Learners

Like the broader educational system, mathematics education is influenced by culture (Nasir et al., 2008). Researchers have characterized mathematics classrooms as racialized and white institutional spaces (Battey & Leyva, 2016; Berry, 2005; Martin, 2019, 2006). Racialization in

math education refers to how race and racial identities influence the teaching and learning of mathematics (Martin, 2019; Nasir, 2011). This includes how educators perceive certain racial groups' mathematical abilities and potential. Cultural portrayals of those who excel in math are often white or Asian males, while Black students are frequently underrepresented in the math sphere (Ladson-Billings, 1997; Martin, 2009; Nasir & Shah, 2011). Racial storylines of Black students being less proficient in mathematics than other cultural groups delegitimizes them as learners and doers of mathematics, affecting their self-perception and math identity (Nasir et al., 2012; Martin, 2000). Math identity refers to individuals' beliefs about their ability to participate and perform effectively in mathematical contexts and to use mathematics to alter the conditions of their lives (Martin, 2009). Negative perceptions and beliefs about math abilities can limit Black students' engagement with academic material and impact their learning, further reinforcing the view that Black students are less capable in math classrooms than other students (Nasir et al., 2012).

Math classrooms tend to reflect dominant, white, middle-class values, which influences teaching practices and student interactions (Ladson-Billings, 1997). This ideology of whiteness positions white people, white actions, and white ideas as more valued in mathematics education (Battey & Leyva, 2016; Nasir et al., 2012). Fluency in this culture is power (Berry, 2005). Thus, a lack of cultural assimilation results in devaluation, oppression, and discrimination against those perceived as not white (Battey & Leyva, 2016). This is evident in discriminatory practices for Black students, such as limited representation in the curriculum, lower quality of instruction, and deficit views of Black students' mathematical abilities (Battey & Leyva, 2016).

Teachers who endorse the notion of colour-blindness further alienate Black students and Black culture from math classrooms (Cunningham, 2021). Colour-blindness refers to perceptions of all students as culturally neutral. For instance, some teachers claim they do not see colour, just

students. Because culture significantly impacts learning (Barta & Brenner, 2009), failing to acknowledge cultural differences invalidates the historical and ongoing educational inequities that Black students endure (Cunningham, 2021). This view also prevents the positive construction of racial and math identities in math classrooms (Martin, 2009). Colour-blind perspectives may explain why, when it comes to teaching math, sociocultural knowledge is often not considered (Abdulrahim & Orosco, 2020), and the majority of mathematics educators continue to teach math in a way that discounts students' cultural and linguistic strengths (Celedón-Pattichis et al., 2018).

Traditional Mathematics Instruction for Black Students

The way mathematics is traditionally taught to Black students fails to benefit them. Students of colour receive less challenging and more repetitive curricula and less instruction in higher-order skills development (Hammond, 2015). An emphasis on rote memorization and lectures fosters dependent learners, leaving Black students with only a surface-level understanding of concepts and the ability to regurgitate facts (Hammond, 2015). Consequently, these students lack the necessary skills to apply their knowledge in new situations and solve math problems in the real world (Hammond, 2015).

The dominant instructional approach for teaching Black students mathematics includes test-driven instruction, or "teaching to the test" (Davis & Martin, 2018, p. 43), and rote memorization (Ellis & Berry, 2005). Teaching to the test refers to mathematical instructional practices wherein educators use narrow, test-focused instructional approaches prioritizing performance over learning (Davis & Martin, 2018). Specifically, it emphasizes remediation over prevention, skills-based instruction over critical thinking, easier curriculum materials, and little teacher flexibility in instruction and decision-making (Davis & Martin, 2018).

Rote memorization to teach foundational math concepts often includes decontextualized drill and practice questions, which fails to promote active reasoning and problem-solving skills

(Berry et al., 2014). It also does not incorporate lived experiences and culture in the math classroom. The lack of cultural relevance impedes Black students' mathematical development and their ability to use math to challenge and critique social issues (Cunningham, 2021), which is essential for improving individual and group conditions (Davis & Martin, 2018).

These narrow instructional approaches hinder opportunities for Black students to take advanced mathematics courses, which can prevent pursuing higher education and limit future career options (Flores, 2007; Martin, 2007). This also may result from Black students having less access to qualified mathematics teachers who deeply grasp the subject and understand the Black culture (Flores, 2007; Martin, 2007), making translating mathematical knowledge and teaching in culturally relevant ways difficult. Instructors often use teaching examples that are neutral regarding race; however, these contexts do not significantly connect to Black students' lives outside of school, making this type of math less relevant to them (Cunningham, 2021).

Culturally Relevant Mathematics Pedagogy

Mathematics education is a matter of educational equity. Ensuring that all students, regardless of their background, have access to high-quality math instruction is essential. Culturally relevant pedagogy in math instruction can make learning more accessible and engaging for students from diverse backgrounds, promoting equity and inclusion (Ladson-Billings, 1994, 1995a). This is essential for closing achievement gaps for Black students, including in mathematics (Ladson-Billings, 1997). Access to solid math education can help even the playing field, providing Black students with the tools they need to pursue higher education and meaningful careers (Berry, 2005).

Tate (1995) called for an Africentric approach to mathematics education, emphasizing its importance in creating a more inclusive and relevant learning environment. According to Tate (1995), “Africentricity is not a static ideology but rather a dynamic strategy for understanding the thinking and experiences of African American students in school mathematics.” (p. 166). This

perspective highlights that Africentricity is not merely a theoretical framework; it is a flexible and evolving approach that prioritizes the lives and experiences of Black students. By placing their backgrounds and realities at the center of the curriculum, this method seeks to teach mathematical concepts in a way that resonates with students, while also inspiring them to engage in social change and make a positive impact in their communities.

Africentricity ushered in a movement toward culturally relevant pedagogy in mathematics. According to Martin (2000), culturally relevant pedagogy is crucial in helping learners from diverse backgrounds develop their mathematics identities. It also facilitates their socialization by integrating math into students' personal lives (Martin, 2000). Leonard (2018) shared this perspective, emphasizing cultural relevance in math instruction to empower students to connect their mathematical learning to their cultural backgrounds and experiences, thus increasing their engagement and achievement in mathematics. Tate (2005) stated, "One barrier to an equitable mathematics education for [Black] students is the failure to 'center' them in the process of knowledge acquisition and to build on their cultural and community experiences." (p. 35) Thus, the inclusion of culturally relevant mathematics teaching is necessary for culturally and linguistically diverse learners (Abdulrahim & Orosco, 2020).

Teaching Mathematics to Black Students in Culturally Relevant Ways

Successful mathematics teachers incorporate culturally relevant instruction into their mathematics lessons. In a study by Corp (2017), two grade three classes participated in 12 math lessons over a semester. The lessons used culturally relevant stories that featured Black protagonists to teach mathematical concepts. Teachers reported that children in the classes were cognitively, emotionally, and behaviorally engaged during these lessons (Corp, 2017). The use of these stories also led to improved test scores. Additionally, Black children endorsed finding the stories helpful in relating math concepts to everyday life. These results indicate that portraying

diverse characters in math instruction affirmed students' culture, which improved their math problem-solving skills (Corp, 2017).

Another qualitative study with eight elementary teachers found that using culturally relevant pedagogy was essential to Black learners' success in mathematics (Jackson, 2013). Ladson-Billings (1997) noted a deep-rooted affinity for rhythm and pattern in Black culture[3], evidenced by jazz, gospel, rap, poetry, sermonizing, basketball, dance, and fashion. In line with this, the teachers in Jackson's (2013) study incorporated clapping, movement, and rhythm into math lessons. These teachers also capitalized on students' desire to talk and get involved by putting them into leadership roles. Jackson (2013) noted that many Black students enjoy shouting out answers and using call and response during mathematics lessons. When teachers included these characteristics of instruction in math lessons, they found it facilitated participation from Black students (Jackson, 2013). Other studies found that dance, music, oral storytelling, and sung responses helped Black learners grasp challenging mathematics concepts (Bonner, 2014; Bonner & Adams, 2012; Cholewa et al., 2012; Timmons-Brown & Warner, 2016).

Leonard (2008) also discussed the link between mathematics and Black culture. Teachers can demonstrate to students that mathematical concepts are everywhere, including in the patterns of geometric nail designs and hairstyles. For example, she suggested using culturally salient examples when teaching math, such as comparing the costs of maintaining different types of hairstyles over a period of time and determining what percentage of the monthly budget is spent on hair care (Leonard, 2008, p. 163).

Noting the difference between domain and cultural knowledge in math classrooms, Nasir et al. (2008) found that Black basketball players were better able to solve math problems that

[4] This is not to say that Black culture is a monolith or that all Black individuals endorse these cultural characteristics. Ladson-Billings (1997) makes it clear that this is not meant as a stereotypical comment, meaning "all Black people have rhythm," nor do I mean it that way.

reflected their lived experiences with the game. Domain knowledge refers to knowledge valued by mathematics educators and mathematicians; this is commonly what students are exposed to in schools (Nasir et al., 2008). In contrast, cultural knowledge is derived from settings outside of school, usually in students' homes and communities (Nasir et al., 2008). Middle and high school basketball players were asked to solve average and percentage problems in two ways. One set of tasks required students to complete a typical math worksheet. The other set asked students to solve basketball-type problems. The school format for calculating a percentage was 7/11 = ___% compared to the basketball format, which was "Say you are at the free-throw line. You take 11 shots and you make seven of them. What's your percentage from the line?" (Nasir et al., 2008, p. 189). Students who solved the basketball problems used more inventive strategies, while those solving school-format problems often used misremembered and misapplied algorithms.

Importantly, those who solved the basketball problems before solving the school problems performed better on all problems, whereas those who solved the school problems first scored lower on all problems. Nasir and colleagues (2008) suggested that cultural and domain knowledge boundaries were blurred for those who solved basketball problems first, allowing these students to view themselves as knowledge experts, which increased their confidence in tackling all types of problems. In contrast, receiving school problems first kept cultural and domain knowledge separate, which contributed to views of failure and incompetence, affecting students' abilities to solve culturally relevant problems later on (Nasir et al., 2008). These results demonstrate how the type of question and the expected solution method can affect students' confidence and performance when solving math problems.

Addressing social justice issues is a primary component of culturally relevant math instruction (Ladson-Billings, 1994, 1995a). Teaching mathematics for social justice empowers students to use math to analyze and critique societal structures, which builds individual and social

agency (Gutstein, 2006). This approach fosters student engagement and promotes the development of math identities, legitimizing Black students as capable doers of math (Gutstein, 2006; Leonard et al., 2010). Recent findings suggest math identity is tied to math success for Black learners even after controlling factors such as socioeconomic status (Gonzalez et al., 2020).

Tate (1995) described a teacher who taught math for social justice by having her Black students advocate for closing or relocating 13 liquor stores near their school in Michigan. The students examined data, local laws, regulations, and codes, obtained maps from the city planning commission, and communicated their findings to the city council and the media, resulting in the closure of two stores and the issuance of 200 citations to liquor store owners (Tate, 1995). This example illustrates how teaching math for social justice can equip students with knowledge to solve real-world problems that affect their communities, which, in turn, can drive societal change (Leonard et al., 2010).

Black Mathematics Success Stories

Black success stories in mathematics serve as a counterpoint to the "gap gazing fetish" in education research (Gutiérrez, 2008, p. 357), which focuses on the achievement gap and alleged deficiencies of Black students in mathematics. Berry (2005) provided descriptive case studies of two Black male middle school students who experienced success in the subject; they were both in academically gifted programs and taking high-tracked math courses. Barriers to success and compensatory factors were explored through interviews with the students, their parents, and their teachers. Prominent themes included individual discrimination, early experiences, support systems, drawing on school and community resources, and self-empowerment (Berry, 2005). The biggest barrier to academic success was individual discrimination. Discriminatory practices included failure to recognize students as academically gifted and cultural differences in what was deemed appropriate classroom behaviour by teachers. For example, a teacher noted symptoms of attention-

deficit/hyperactivity disorder (ADHD) in one of the boys due to his movement and activity in the classroom. A psychological assessment determined his actions were the result of boredom from not being academically challenged, not ADHD (Berry, 2005).

Fortunately, these boys had compensatory factors that served to combat the individual discrimination they faced at school (Berry, 2005). Regarding early experiences, both students were exposed to educational materials such as flashcards and number games at home from a young age, and they had positive experiences with school in the early grades. Support systems, including parents, extended family, and positive community role models, were prominent in these boys' lives. Their parents valued education and held high expectations for academic success. They also served as academic resources and advocated for their children to ensure they received equitable treatment and proper course placement. Moreover, these boys drew on school and community resources. They attended church, played sports, and participated in academic programs outside school. Lastly, these students possessed a high level of self-empowerment. They were motivated to succeed in math and believed in their math abilities. High teacher expectations and care and concern for their students' success contributed to their sense of self-empowerment (Berry, 2005).

A qualitative metasynthesis also highlighted how Black students navigate barriers to experience success in the subject (Berry et al., 2014). Three prominent themes emerged from this research, including a) awareness and access, b) images, and c) agency. Black learners faced awareness and access issues during their math journeys at school. Being aware of academic opportunities, such as taking advanced math courses or enrolling in gifted programs, did not guarantee access. However, students who gained access to higher-tracked math courses received better-quality teaching and higher expectations from their teachers and peers. Secondly, learners developed self-images based on their values, allowing them to negotiate their academic and racialized math identities. Black students as successful math doers oppose racialized narratives of

Black learners being unskilled at math. Students often reconciled this dichotomy with images of positive role models and behaviours that proved their worth as legitimate participants in math (e.g., being the first to raise their hand when the teacher posed a question). Lastly, learners developed agency. Those with a strong sense of agency asserted their identities and made decisions regarding their participation in advanced mathematics, choosing paths based on their negotiated definitions of success. These students also demonstrated resiliency and persistence in the face of challenges and experiences with non-success. Despite myriad barriers, these counterstories evidence Black success in mathematics, providing direction into a future that values Black students' intellect, ability, and potential (Berry et al., 2014).

Black Nova Scotians' Mathematics Performance

Like many provinces across the country, there are concerns about mathematics achievement in Nova Scotian schools. Mathematics achievement gaps persist in schools serving historically excluded and underserved communities (Throop Robinson et al., 2021). Data from 2016 to 2020 obtained by the grade six provincial mathematics assessment showed a 16% to 21% gap between students of African descent and all other students (NS DEECD, 2020). Black students are not learning and achieving in math at the same rate as their peers.

Disaggregated data from the 2023-2024 school year demonstrated that only 53% of Black students in grade six performed at or above expectations on provincial standardized tests in mathematics compared to 68% of all other students who performed at or above provincial expectations (NS DEECD, 2023a). In the 2022-2023 school year, 64% of grade three students of African descent performed at or above expectations in mathematics (NS DEECD, 2023b). As mathematics becomes more difficult with advanced grades, these percentages decrease. In grades six and eight, only 50% and 34% of Black students were at or above expectations in mathematics, respectively (NS DEECD, 2023a, 2023c).

The 2021-2022 Nova Scotia assessment in mathematics showed similar trends for students self-identifying as Black. Only 55% of Black students in grade three and 48% of students in grade six met mathematics expectations (NS DEECD, 2023a). In grade eight, a mere 31% of Black students performed at or above the expected level in math (NS DEECD, 2023c). These statistics emphasize the urgent need for mathematics teaching and assessment practices that are more relevant to the cultures and experiences of Black learners in Nova Scotian schools. Currently, there are no culturally appropriate assessment tools available for Black learners in any academic subject, including mathematics. However, culturally relevant practices in math instruction have seen some success with Black youth, as discussed below.

Culturally Relevant Mathematics Pedagogy in Nova Scotia

A recent mixed methods study examined the impact of a two-year elementary (K-8) mathematics pedagogy program called the Certificate in Elementary Mathematics Pedagogy (CEMP) for in-service teachers in Nova Scotia (Throop Robinson et al., 2021). Findings from online surveys and follow-up interviews revealed that most teachers (88%) reported improved student engagement and increased student achievement in mathematics (82%) in their classrooms after completing the program. However, concerns remained about improving mathematics achievement for culturally diverse students. For instance, only 61% of teachers endorsed that the CEMP deepened their understanding of systemic factors that result in the achievement gap among students in NS. Several educators asked for culturally responsive pedagogy to be incorporated into all courses offered through CEMP, and more cultural relevance in teaching Black students mathematics was emphasized. Thus, despite advancements in culturally relevant math teaching, more must be done to enhance teacher understanding of the impact of culture on math success for this population.

Throop Robinson and colleagues (2021) agreed that the CEMP would benefit from

including Indigenous and Africentric community-focused projects, such as *Show Me Your Math* and *Connecting Math to Our Lives and Communities* (Lunney Borden et al., 2019). Authors noted that enhancing connections with Black communities provides "increased opportunities for reconciliation and curriculum renewal…and embrace[s] multiple ways of knowing and being from African Nova Scotian perspectives in the mathematics classroom." (Throop Robinson et al., 2021, p. 870) Indeed, Black learners, families, and communities must be included in the ongoing dialogue regarding educational policies and mathematics instruction.

The *Africentric Math Cohort*, implemented in Halifax Regional Centre for Education high schools, is a real-world example of culturally relevant mathematics pedagogy in the province (Halifax Regional Centre for Education [HRCE], 2018a, 2018b, 2019). Embodying CRP principles, the *Africentric Math Cohort* connects Black history and culture to math instruction. It provides access to positive Black role models in the community, offers high teacher expectations and involvement, and fosters relationships between students and teachers. Participants of this program reported a clearer understanding of math concepts and their culture, more confidence in solving math problems, and a greater connection to their communities (HRCE, 2018a, 2018b, 2019).

Conclusion

Black students in Canada face systemic inequities in the education system. Racism and discriminatory practices such as racial slurs, low teacher expectations, disproportionate disciplinary actions, and a lack of culturally relevant curriculum persist for Black learners. In addition, current cognitive and academic assessment measures, including mathematics achievement tests, are discriminatory and unjust for Black students. How mathematics has traditionally been taught lacks cultural relevance and applicability to their daily lives. These factors sustainably impact mathematics achievement for this population. To rectify the opportunity gap and disproportionate

placement on IPPs for Black students in Nova Scotia, mathematics instruction and assessment tools used by school psychologists to assess math abilities must be revisited and reformed.

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CHAPTER TWO

Standardized Assessment in Mathematics: A Qualitative Exploration of Black Nova Scotian Perspectives and Experiences

School psychologists' primary and enduring role in the Canadian education system is conducting psychoeducational assessments (Corkum et al., 2007; King et al., 2022). Part of this process involves administering standardized academic achievement tests, which provide information about students' abilities in reading, writing, and mathematics (Benson et al., 2019; Sattler, 2008). Examples of achievement tests include the Wechsler Individual Achievement Test (WIAT; Wechsler, 2009) and the KeyMath-3 Diagnostic Assessment (KeyMath-3 DA; Connolly, 2008a). These tests are norm-referenced, meaning students' performance is compared to a large, normative sample of individuals of similar age and developmental levels (Kanwal & Farooq, 2021; Lok et al., 2016). Data from these standardized assessments can inform diagnoses, such as specific learning disorders, and guide the implementation of evidence-based interventions to support academic success within the school system (Fletcher & Miciak, 2019).

The use and application of standardized tests with Black populations have long been criticized. Although much research exists on the misuse of cognitive or IQ tests with Black individuals, there is a paucity of research on academic achievement tests with this population. It has been suggested, however, that similar problems exist. One concern is that standardized academic achievement tests fail to account for cultural differences in students' knowledge. This means that factors other than academic skills, such as language and culture, are measured to some extent by these tests (Pitoniak et al., 2009). Thus, performance may reflect acculturation to European hegemony rather than true academic abilities. In addition, normative samples tend to be predominantly white, to the exclusion of culturally diverse populations (Rhodes et al., 2005).

Black students must be represented in the normative sample to draw accurate conclusions about their abilities. Test results should not be considered valid if a student's cultural background significantly differs from the standardization group (Flanagan et al., 2013; Sattler, 2008). More research is needed to develop and pilot culturally relevant assessment tools appropriate for diverse student populations, as this is currently lacking in empirical literature and in practice.

The KeyMath-3 is a commonly used mathematics achievement test that helps identify students' strengths and gaps in mathematical knowledge (Connolly, 2008a). In the most recent Canadian edition of the KeyMath (Connolly, 2008b), there is a consistent issue of underrepresentation of Black students in the normative sample. Unlike the U.S. sample, there are no details about the characteristics of the Canadian standardization sample for the KeyMath-3. Besides noting that the sample was selected using the 2006 Canadian Census data, the manual does not report racial or ethnic backgrounds (Connolly, 2008b). This lack of transparency raises questions about the sample's racially monolithic nature, which remains unaddressed to this day. More research on the KeyMath-3, especially the Canadian edition, must be undertaken to examine its validity, reliability, and utility across diverse populations.

Although there are issues with assessment materials for Black students (Graves, 2022), standardized test data continues to be used for making diagnostic and placement decisions (Benson et al., 2019; Rosli, 2011). These tests were designed from a cultural deficit framework, creating racial hierarchies (Davis & Martin, 2018) and reinforcing negative judgments of Black students' academic capabilities based on standardized test scores (Lewis et al., 2008). Administering tests that lack cultural relevance has contributed to what some scholars call the achievement gap. The achievement gap refers to enduring differences in academic achievement observed between minority groups, such as Black learners, and their white peers (Gutiérrez,

2008). Black students consistently score lower on standardized tests than their white counterparts (Ladson-Billings, 2006; Leonard, 2018). This perpetuates the deficit-oriented perspective that falsely attributes achievement discrepancies to ethnicity and race (Graves & Blake, 2016). However, race, ethnicity, and socioeconomic status do not cause academic failure (Gay, 2010). The opportunity gap is a more accurate term, as it highlights Black students' current and historic educational disparities. Indeed, Ladson-Billings (2006) refers to the achievement gap as the educational debt, underscoring the institutional inequities Black students face at school.

Black Students in the Nova Scotia Education System

The Black population in Nova Scotia has a rich history spanning over 400 years. There are over 52 unique Black communities of diverse descendants across the province (Sadlier et al., 2018). In November 2021, 7% of the student population in Nova Scotia self-identified as being of African Heritage (Nova Scotia Department of Education and Early Childhood Development [NS DEECD], 2021). Approximately 7,700 Black students are currently enrolled in public school systems.

Like in other parts of the country, Black youth in Nova Scotia face systemic and intuitional inequities in the education system. Black learners indicate feeling disconnected from the public education system (African Nova Scotian Affairs, 2017; Halifax Regional School Board, 2003; Smith et al., 2005). They also frequently report that their teachers do not understand Black Nova Scotian culture, nor do they possess adequate training in race relations and Black history (African Nova Scotian Affairs, 2017; Halifax Regional School Board, 2003; Hamilton-Hinch et al., 2017; Smith et al., 2005; United Nations, 2014). Racist and discriminatory practices, such as low teacher expectations, stereotyping, and lack of culturally relevant curriculum, are other forms of miseducation endured by this population (African Nova

Scotian Affairs, 2017; Black Learners Advisory Committee [BLAC], 1994; Dei, 2008; Hamilton-Hinch et al., 2017; Smith et al., 2005; United Nations, 2014). Moreover, Black students in Nova Scotia experience higher out-of-school suspension rates than other students in the province (Woodbury, 2016).

Another form of discrimination in Nova Scotian schools is the disproportionate placement of Black students on Individual Program Plans (IPPs). IPPs are developed for students who cannot meet the curriculum goals of the public school program or for whom the goals are not applicable. IPPs replace some or all of the standard curriculum goals with individualized outcomes (NS DEECD, 2016). Consequently, students on IPPs do not adhere to standard classroom curricula but instead follow customized curricula tailored to their strengths, interests, and challenges. Students may be on an IPP for a single subject, such as mathematics, or multiple subjects, such as mathematics and English Language Arts. Findings from a province-wide review of IPP data indicated that Black students are 1.5 times more likely than other students to be placed on an IPP in at least one subject (NS DEECD, 2016). The percentage of non-Black students on an IPP was 5.4%, compared to 7.9% of Black students with an IPP (NS DEECD, 2016). Additionally, the review panel deemed only 66% of the programming plans to be the most suitable option for Black students' learning and social needs (NS DEECD, 2016). Thus, 34% of Black learners placed on IPPs could have benefited from other educational or behavioural improvements instead of an IPP.

These findings mirror a report published 30 years ago by the Black Learners Advisory Committee (BLAC, 1994). Known as the BLAC report (1994), this document outlined the disparities faced by Black learners in the Nova Scotian education system. Overt and covert racism, such as racial slurs, name-calling, stereotyping, and differential treatment by teachers,

were identified as the main issues for Black students at school (BLAC, 1994). The BLAC report also found that Black students were disproportionately streamed into less challenging, non-academic courses, regardless of academic ability or aptitude. Students were dissuaded from taking advanced mathematics and science courses and steered toward vocational and general programs by guidance counsellors. While not labelled IPPs at the time of the BLAC report's (1994) publication, these practices reflect the current realities of Black students' overrepresentation of IPPs in this province.

A recent study by Frempong and colleagues (2023) examined how intersectionality affects the placement of Black students on IPPs. Intersectionality refers to the multiple, overlapping dimensions of identity that cannot be fully understood in isolation (Collins, 2018). Students with intersecting identities face additional educational barriers (Frempong et al., 2023). For instance, Black students from low socioeconomic status (SES) backgrounds were more likely to be placed on IPPs compared to students with only one of these cultural identities (i.e., being Black or being from a low SES background, but not both) (Frempong et al., 2023). These authors argue for an intersectionality framework to be added to Nova Scotia's inclusive education policy to support the most vulnerable students (i.e., those with intersecting identities).

Black Nova Scotians' Mathematics Performance

Mathematics is a crucial academic subject for all learners. Achievement gaps persist for Black students in Nova Scotian schools, including in mathematics (Thiessen, 2009; Throop Robinson et al., 2021). Data from the grade six provincial mathematics assessments collected between 2016 and 2020 revealed a 16% to 21% gap between students of African descent and their peers (NS DEECD, 2020). More recent data from the 2023-2024 school year showed that only 53% of Black students in grade six performed at or above expectations on provincial

standardized math tests (NS DEECD, 2023a). In comparison, 68% of all other students met or exceeded these provincial expectations (NS DEECD, 2023a). Although the gap has decreased in recent years, Black students are still not achieving in math at the same rate as their peers. This is a significant problem, as performance on standardized math assessments may influence IPP placement.

The Present Study

Research on cognitive testing with Black populations is extensive (see Graves & Blake, 2016, for an overview). However, there is a noticeable gap in the research pertaining to standardized achievement tests and Black students. To fully understand the impact of standardized math assessments on this group, it is crucial to consider their perspectives and experiences. While some research exists on the math experiences of Black populations in the U.S., there is a paucity of research on the lived experience of Black Nova Scotian learners in the public education system (Hamilton-Hinch et al., 2021). Furthermore, no studies examine Black Nova Scotians' experiences with standardized math assessments. As such, this study aims to address that gap and contribute to the Canadian body of empirical research on this demographic.

Given that much of psychological research tends to focus on participants from WEIRD backgrounds (Western, Educated, Industrialized, Rich, and Democratic), this work is particularly important. A review of 1,213 articles published between 2010 and 2019 in four key school psychology journals—*School Psychology Review, Journal of School Psychology, Psychology in the Schools, and School Psychology*—reveals that the field often overrepresents white students from middle- to high-SES backgrounds to the exclusion of many other demographics (Schanding et al., 2021). Therefore, we must include diverse and historically marginalized populations in school psychology research to ensure a more comprehensive understanding.

The current study is part of a larger project exploring the impact of diagnostic[4], or standardized, assessments on math learning among Black and Mi'kmaw students in Nova Scotia. The research results from ongoing collaboration with local Black and Mi'kmaw communities, focusing on strategies that aim to decolonize (i.e., make less Eurocentric) how math is taught and assessed in Nova Scotian schools. Elevating Black and Indigenous epistemological perspectives will allow our research team to analyze assessments and explore new ways of examining growth in mathematics understanding among these populations. As such, the current study's findings will aid in informing the development of culturally relevant mathematics assessment tools for Black learners in the Nova Scotia educational system.

Research Questions

The current study seeks to answer the following three research questions:

1. What are the unique perspectives and experiences of Black Nova Scotians with standardized mathematics achievement tests?
2. What is the cultural appropriateness of school-based assessment practices for evaluating the mathematics abilities of Black students in Nova Scotia?
3. What pedagogical factors and assessment improvements can increase mathematics achievement for Black Nova Scotian learners?

Theoretical Framework

To understand and interpret Black individuals' perspectives and experiences with mathematics assessment, employing a theory connecting culture to assessment practices is crucial. Considering the inextricable link between instruction and assessment, culturally relevant pedagogy (CRP) is the theoretical framework for interpreting participant interview data. Coined

[4] The larger study refers to 'diagnostic' math assessment instead of standardized assessment; therefore, that is the term used when discussing it.

by Ladson-Billings (1994), CRP empowers students "intellectually, socially, emotionally, and politically by utilizing cultural references to impart knowledge, skills, and attitudes" (Ladson-Billings, 1994, pp. 17-18). This approach emphasizes academic success, cultural competence, and critical consciousness by incorporating the cultural backgrounds of Black students in the classroom (Ladson-Billings, 1995). In line with this approach, assessment should be multifaceted, wherein various forms of excellence are recognized and celebrated (Ladson-Billings, 1994; 1995). As such, this framework is an appropriate lens for understanding mathematics assessment practices in Nova Scotia's education system.

Method

Positionality

Recognizing the role that race, gender, and power play in the research process, I must acknowledge my positionality within this research. I am a white, heterosexual, cisgender female. I grew up in a low-income, culturally and racially diverse neighbourhood in Windsor, Ontario, a city bordering Detroit, Michigan. Living in a border city, I was heavily influenced by aspects of Black American culture (i.e., news, media, music, literature, food). I acknowledge being able to enjoy and benefit from Black culture without ever experiencing Black struggles. Despite the impact Black American culture has had on me, positionally, I am an outsider. I am different from the group I am studying. I am privileged because of my race, ethnicity, social class, education, and access to resources. I have and continue to receive numerous unearned advantages (e.g., social, professional, academic, economic, educational, legal) that Black people do not.

Two primary purposes motivate me to do this work. First, I want to acknowledge my position and privilege and work as an ally alongside Black and Indigenous colleagues, knowledge keepers, and mentors to ensure that I practice ethically and equitably when

establishing myself as a psychologist in NS schools. As such, I take this research opportunity very seriously. In representing the stories of Black Nova Scotians, I am committed to being aware of my positionality, taking special care to honour and accurately represent their voices.

Another reason I am motivated to conduct this research is my early experiences at school. I struggled with reading and mathematics throughout elementary school, failing the grade three Ontario provincial standardized test. Academic concepts that came quickly to my classmates were difficult for me, yet these struggles were unidentified by my teachers. Without instructional intervention at home, I would have slipped through the cracks at school. Because of my early educational experiences, I am sensitive to the academic difficulties of all students. Although I understand what it is like to struggle in school and not receive help, I do not know how it feels to be oppressed and cast aside due to the racist nature of educational institutions. My background and school experiences have contributed to my dedication to bringing equity-deserving voices to light and elucidating injustices within the education system.

Research Design

The present study is descriptive, deductive, and qualitative. In contrast to quantitative methods, qualitative methods aim to provide an in-depth understanding of a relatively small number of cases. It captures aspects of the social or psychological world (Braun & Clarke, 2013) and examines personal experiences, providing a "rich tapestry of understanding" (Braun & Clarke, 2022, p. 6). As qualitative methods emphasize individual meaning-making practices and multiple truths (Braun & Clarke, 2022), they are ideal for my study's goal of presenting the unique perspectives and experiences of Black Nova Scotians regarding math assessment.

Participants

Twelve participants were recruited from the Delmore "Buddy" Daye Learning Institute (DBDLI), a local organization for Africentric education and research. Participants were DBDLI staff and community members with various areas of expertise. They comprised current and past educators, researchers, parents, and former students in the Nova Scotia education system. Of the participants, six identified as female, five as male, and one as non-binary. All participants self-identified as Black, with one identifying as Black and Indigenous. Their ages ranged from 23 to 64, with an average age of 38.75 years (SD = 13.17). See Table 1 for participant demographic details.

Procedure

Potential participants received a recruitment email from one of three research assistants that provided information about the study and asked if they were interested in being interviewed (Appendix A). If they expressed interest, they were emailed invitations to participate (Appendix B) and consent forms (Appendix C). They were asked to sign and return the forms electronically or bring them to the scheduled interview.

The current study received ethics clearance from the University Research Ethics Board (UREB) at Mount Saint Vincent University (MSVU). The larger study received ethics clearance from St. Francis Xavier University (StFX). Before the interview began, one of the research assistants reviewed the consent form and allowed time for questions. The interviews commenced once consent was obtained. Participants could pass on questions they did not wish to answer and withdraw participation at any time. However, after July 2024, their data could no longer be removed from the dataset as analysis had begun.

Interviews with participants were conducted in the summers of 2022 and 2023 (June-July 2022 and June-July 2023). Interviews were one-on-one, semi-structured, and led by one of three research assistants. They lasted approximately one hour and were audio-recorded. During the interviews, participants were asked open-ended questions regarding mathematics assessment and instruction. These questions included demographic information and four core questions (Appendix D). Follow-up questions were asked to clarify and expand upon the topics discussed, as needed. After the interviews, one of the research assistants transcribed the audio files using the Microsoft Word Transcribe function. The audio recordings and transcripts were reviewed and edited to ensure the transcriptions matched the recordings. Once this was done, I began analyzing the data.

In the current study, I analyzed participant interview data (i.e., transcripts) and conducted participant checks to ensure accuracy and validity. During the summer of 2023, I interned at DBDLI, an opportunity funded by Mount Saint Vincent University and MITACS. The larger project is funded by a Social Sciences and Humanities Research Council (SSHRC) Insight Development Grant awarded to Dr. Lunney Borden and a research team at St. Francis Xavier University. Throughout my internship, I engaged with the community by volunteering, attending meetings and workshops, and learning about the team's current and past research. Participant checking, a process in qualitative research where participants validate their data, occurred informally during lunches, events, presentations, and meetings. During these interactions, I paraphrased and confirmed my understanding of what participants communicated during their interviews. Overall, my experiences during this internship were immersive, aligning with the principles of conducting research within a community (McAvoy et al., 2000).

Data Analysis

Reflexive thematic analysis (TA) was used to analyze the interview data. Thematic analysis examines semantic and latent patterns within datasets (Braun & Clarke, 2006, 2013). This methodological technique is often used to interpret content in semi-structured interviews, which shapes theme development (Braun & Clarke, 2006). Self-reflexivity is an approach to thematic analysis which involves a disciplined, critical, and ongoing reflection on one's role as a researcher and how this influences the knowledge produced from research (Braun & Clarke, 2022). To this end, I journaled my reactions, emotions, and thoughts throughout the data analytic process. I reflected on my responses and biases, thinking about how my experience in the education system and worldviews shaped my interpretation of the data. I also made extensive notes linking prominent concepts to the empirical literature, connecting past research to participants' responses.

The six steps to reflexive thematic analysis outlined by Braun and Clark (2022) were followed to analyze the interview transcripts. These steps include familiarization and immersion with the dataset (phase 1), generating initial codes (phase 2), constructing initial themes (phase 3), developing and reviewing themes (phase 4), refining, defining, and naming themes (phase 5), and reporting findings and writing the paper (phase 6). TA is an iterative process; thus, these six steps did not follow a linear pattern but flowed into each other throughout the data analytic process.

Interview data were coded using Excel, and the comment function was used in Microsoft Word. After reading the transcripts, codes were assigned based on culturally relevant pedagogy as the guiding theoretical framework. These codes changed and evolved throughout this process, with codes added, deleted, and revised. Themes also changed during the writing process,

something not uncommon in thematic analysis (Braun & Clarke, 2022). Dr. Conor Barker, my thesis supervisor and collaborator on the larger project, reviewed and validated all data, codes, and themes.

Results

Participants provided insights into mathematics instruction and standardized math assessment from various perspectives. Perspectives came from their lived experiences, their experiences as educators, as researchers, and as parents with children in the Nova Scotia school system. Themes center around each research question and include 1) negative experiences with math assessments, the use of a one-size-fits-all approach, flawed assessment tools, and high-stakes testing, 2) a lack of culturally relevant math assessments, and 3) suggestions for pedagogical and assessment improvements, including building students' confidence and involving parents in math instruction, and ensuring that both instruction and assessment for Black students reflect Africentric principles and their lived experiences. See Table 2 for an overview of the results.

Mathematics Assessment Perspectives and Experiences

Research question one explored participants' unique perspectives and experiences surrounding standardized mathematics achievement tests. Respondents indicated four prominent themes: negative experiences with the assessment process, a one-size-fits-all approach to mathematics assessment, flawed assessment tools, and high-stakes testing.

Negative Experiences with Mathematics Assessments

Most participants (10 out of 12) reported negative experiences with mathematics assessment in the education system, especially those who struggled with the subject. Participant 8 described her experience with math assessments as "very traumatic," "degrading,"

"demeaning," and "dehumanizing." She expressed that standardized tests deeply affected her confidence in math. Speaking of their utility, she said:

> These assessments just do not help. Looking over it, it might seem that people see where [students] are, but it does not help those experiencing opportunity and learning gaps. It makes it worse for them, as it did for me.

Participant 10 described the assessment process as "long and arduous," which students must push through or endure. Discussing her experiences as a parent and an educator, Participant 7 said math assessments "fit into the category of not positive" in her mind. She noted the importance of Black parents being aware of standardized assessments and their impact on Black students, saying she remains "suspicious" of these tools.

Two out of 12 participants reported neutral feelings toward mathematics assessments. They viewed these tests as routine or simply another task to complete at school. Participant 5 said, "I've never had an overwhelming negative or positive experience with them. I just did it." Participant 11, a non-binary student who attended elementary and high school in Nova Scotia, also endorsed neutral views, saying they had few memories of the assessment process: "I feel like it would stand out to me because there's so many things having to do with my ethnicity that stand out from school, but that's not one of them."

None of the participants endorsed positive views of mathematics assessments for this population. However, Participant 10 discussed their value, stating that assessments are necessary to gather data about students' struggles and inform interventions in mathematics. She said, "Assessment and intervention go hand in hand" and "everything starts with assessment." Despite their utility, she mentioned the importance of maintaining Black students' dignity throughout the assessment process.

Mathematics Assessments Use a One-Size-Fits-All Approach

Another prominent theme was how mathematics assessments use a one-size-fits-all approach, which overlooks Black students' unique strengths and individuality. Nine out of 12 respondents endorsed this theme. Participant 4 pointed out this problem, stating, “The biases that are in those assessments…it doesn't really take into account all these other things and how people learn. It's just a one-size-fits-all kind of approach, right?” Other participants agreed that assessments do not capture the diverse ways students demonstrate their understanding of math concepts. Bemoaning the heterogeneity of assessments, Participant 12 noted that the same test is given to all students, regardless of their cultural backgrounds. She said, “I don't see a distinction between the diagnostic that is done for the Black person with the Black background and the white person.” Despite all students being subjected to the same standardized tests, Participant 2 pointed out that "these tools might not work for every kid.” Issues with the content of math assessments were also discussed. Participant 8 raised concerns about "random questions,” while Participant 7 referred to the questions in math assessments as “generic.” These remarks suggest that the questions lack coherence and relevance, with restrictive ways of knowing and doing math.

Participants endorsed similar opinions about math instruction in Nova Scotian schools. They agreed that while various ways to learn and understand mathematics exist, math instruction is limited and narrow in this province. Participant 6 lamented that “everything is the same” for every student. Although “there cannot be only one way to do everything,” diverse problem-solving strategies are not encouraged in math classrooms, according to Participant 1. Participant 11 emphasized a lack of practical application, noting that learning math in only one context hindered their ability to apply math knowledge to solve future problems. This circumscribed way

of learning and assessing math was seen as stifling Black learners' interaction with the subject, affecting their performance on assessments and in math classrooms.

Participants also discussed other factors that may affect Black students' performance on math assessments. Participant 6 stated that using a one-size-fits-all approach to assessing math skills is not suitable, especially for students who have difficulties with traditional exams or anxiety surrounding test-taking. She advocated using Legos and currency to demonstrate mathematical concepts instead of solely relying on standardized math assessments where "all students are given the same questions, regardless of their individual strengths and weaknesses." Expanding on the inflexibility in the assessment process, she noted that students are not given the opportunity to answer questions they are better at. For instance, if students are strong in interpreting graphs but struggle with multiplication, alternative questions should be available to showcase these strengths.

Participant 6 and Participant 12 also raised concerns about the heavy reliance on reading in math assessments. They noted that students who struggle with reading might not be able to fully demonstrate their mathematical knowledge due to difficulties understanding the questions posed to them. Participants also discussed that the language used in math assessments may impede students' performance. Participant 2 said, "If I use languages that the kids may not be familiar with and therefore might not work for them, not because of its ability to diagnose what the problem is, but just because they do not understand." Participant 11 also cautioned against using "certain sayings and stuff" on assessments as they may not be comprehensible to all students. Thus, when examining students' struggles, especially those from other countries, it is crucial to tease apart: "Is it the language? Is it the math?" (Participant 12) as test performance

may reflect literacy and language barriers instead of actual mathematical knowledge and abilities.

Flawed Assessment Tools

In addition to using a one-size-fits-all approach, participants discussed more significant flaws with mathematics assessment tools. Eight out of 12 participants suggested standardized math evaluations are imperfect instruments and cautioned against their use with Black students. Participant 2 noted, “Just like any other tool, sometimes it works, sometimes, it doesn't. There are a lot of complaints about how these tools were designed. And how [they] might not work for vulnerable children or African Nova Scotia or Indigenous children.” Participant 3 also suggested that minority students were not in mind when assessment tools were created, saying, “The diagnostic assessments must be restructured and revised to accommodate African Nova Scotian and Indigenous students.” He went on to say that these tools would not be his first choice to use with Black students. In agreement, Participant 4 stated that current assessments do not cater to Black students’ needs, while Participant 12 noted that a non-inclusive framework underlies math assessment tools. This narrow lens fails to incorporate a holistic view of Black learners, solely focusing on academic skills. These comments underscore the belief that these tools were designed to benefit specific populations, to the exclusion of equity-deserving groups.

A more significant, overarching issue about mathematics assessments is the foundation from which they were built. Many participants mentioned that standardized math assessments reflect more considerable flaws within the education system, with both education and assessment being based on a racist system that endorses and upholds white values. In discussing the creation of diagnostic assessments and the tendency to be normed on white students, Participant 11 said, “Everything that humans create has remnants of the systemic issues that have also been created

by humans." They stated that assessment tools are based primarily on white values that reflect the "sphere or bubble" surrounding white people. Because the tools have been designed this way, they cannot surpass these limitations. This significantly affects how Black students are assessed and the implications their performance holds for their future. Speaking of Black students' futures, Participant 12 stated, "We can look at that as a tool to actually eliminate some people from going to higher institutes of learning." This participant implied that standardized assessments are used to reinforce false hierarchies and maintain the status quo, including the lack of Black people in STEM-related careers. Participant 4 also pointed out that Black people "have a vast disparity range in terms of STEM."

In addition to flawed tools, some participants mentioned that those administering mathematics assessments may have limitations that prevent them from effectively assessing Black students, such as biases and finite knowledge about them. In speaking of biased assessors, such as school psychologists, Participant 2 said:

> So, just imagine if you have somebody diagnosing a group of kids. In a way, that process has preconceived ideas about them. The person doing the analysis and the testing also becomes a big problem. Yes, because we have preconceived ideas about who the kids are. The identity. The capabilities. And that is, for me, it is a big issue.

According to this participant, Black students are not only up against flawed assessment materials but also potential assessment negligence, which can contribute to how scores are interpreted and diagnoses are made for this population. A lack of exposure to Black students and Black culture may result in prejudgment and prejudicial treatment on the part of the assessor. Treatment may also represent unconscious biases held by the assessor. Participant 12 lamented that since those responsible for assessments are often not the student's classroom teacher, they tend to have

limited knowledge about the student they are evaluating. She raised an important question: “How can you assess a child who you're not teaching?” Can someone accurately assess students with whom they do not have direct teaching interactions or with whom they do not identify culturally?

High-Stakes Testing

Another theme surrounded high-stakes testing and pressure to perform on standardized math achievement tests, a view expressed by half of the participants. Remembering a “whole energy” surrounding these tests, Participant 1 said, “If you do not do OK on this, you are really screwed, right?” She talked about the uncertainty of her results, saying, “You did not know where you stood at all.” Participant 8 noted a similar experience. She knew she “could not fail the test” as her performance would be used to determine what content she would learn the following semester and what courses she could take the following year. In discussing her experience as an educator, Participant 10 recalled spending an entire month mentally preparing her students for annual math evaluations. Despite preparations, some students would vomit due to nerves and the immense pressure to perform well because “there's so much at stake put on them.”

The implications of performance on high-stakes math assessments for Black learners were also discussed. For example, Participant 7, an education researcher and parent, recounted how her child’s standardized math and literacy test results were used to justify transferring him to another school. Without parental advocacy to retain him at his current school, the transfer would have been initiated without parental consent. Participants 1 and 12 also emphasized advocating for their children within the education system, stressing the importance of parental involvement in decisions that affect Black students’ academic futures.

Another concern raised about high-stakes testing was the potential for misdiagnosing disabilities in Black students. Although standardized test performance may lead to a diagnosis, such as SLD, Participant 10 commented that diagnostic labels should not be the end goal. She pointed out that "slapping on a label does not work," stating that the time spent assigning a label could be better used to teach and help the child. That is, the end goal of assessments should not be labels or diagnoses. Assessments should provide data, monitor progress, and inform interventions that best support the student's areas of struggle. Participant 12 also shared her doubts regarding the accuracy of standardized assessments for Black students. She highlighted instances where children had been inaccurately diagnosed, emphasizing the negative impact of misdiagnosis: "You're going to affect a child's entire life." She partially attributed this issue to "ignorance," or a lack of understanding of Black culture among educators and assessors. According to her, existing diagnostic frameworks are not inclusive, yet the results have long-term consequences, such as hindering a student's chances of attending university.

The link between assessment results and IPPs was also discussed. During her work with the Department of Education in Student Services, Participant 7 highlighted the common practice of using test scores to determine IPP placement for Black students. Participant 1 also shared her perspective, noting that many Black youth are placed on IPPs without sufficient understanding or education about what it means for them in the long term. She said:

> There are high numbers of Black youth who are placed on IPP. There's not enough education about IPP for families, and they do not know what it means for the youth or their children when they graduate high school and what it leaves out.

Despite the negative impact of IPP placement, participants mentioned that it often becomes the default for Black students. Participant 12 recounted an experience with her son's math teacher

attempting to place him on an IPP due to difficulties in understanding math, which was later attributed to language differences and varied teaching methods in Canada compared to his home country. Underscoring this phenomenon, Participant 2 added that he frequently encounters parents who are concerned about their Black children being labelled or "designated" as IPP students.

Participants also discussed the adverse outcomes of IPP placement for Black learners. Participant 1 said, "It leaves the Black community at a complete disadvantage, especially right now. It is this nasty swirl that we are in right now that we are trying to get out of." According to this participant, this process affects not only the individual student but also the Black community, perpetuating a cycle of inequity fostered by systemic discrimination. On the individual level, Participant 11 stated that IPPs set Black students up to fail and hinder their academic and social development. Participant 12 expressed similar views, noting that being singled out can impact students' self-esteem and peer interactions. As emphasized by Participant 3, "Having students on IPPs might help, but I don't think it's always the solution."

Participants' perspectives and experiences with standardized mathematics assessments were largely negative. They stated that math assessment tools are flawed for several reasons. For instance, relying on a single test to evaluate the mathematical knowledge of Black students does not account for individual differences, resulting in a one-size-fits-all approach. Furthermore, the high stakes associated with these tests place significant pressure on Black students, as poor performance can lead to misdiagnosis and inappropriate placement on IPPs for this population. This combination of factors underscores the need for more equitable and nuanced approaches to mathematics assessment, which is currently lacking in Nova Scotia's schools.

Cultural Relevance of Mathematics Assessments

Research question two examined the cultural appropriateness of mathematics assessments in Nova Scotian schools. A central theme was a lack of cultural relevance in standardized mathematics assessments for Black learners, a significant reason participants gave for these flawed tools, as discussed above. Nine out of 12 participants expressed that standardized math tests fail to acknowledge or incorporate the cultural values of the Black community. The other three participants could not recall specific details about cultural relevance in math assessments. Participant 1 said, “I think that cultural identity when I was going to school was not considered in assessments at all.” Participant 4 also pointed out the absence of Black culture and voices in math assessments, saying, “Definitely, you can feel the sense that those cultural things are missing.”

Regarding the content and questions on math assessments, Participants 2 and 7 noted a lack of cultural relevance and representation of Black culture: “Those references are often not culturally relevant” and “I did not see or understand the representation,” respectively. When asked whether math assessments honour Black students’ cultural identities, Participant 10 laughed and mentioned superficial and stereotypical attempts at inclusion. Using an example of word problems featuring basketball, she said, “Because, for some reason, they think only Black kids can play basketball. But you know that's how tokenistic it would be.” Thus, attempts at representation are tokenistic at best, according to this participant.

Participants connected mathematics instruction to mathematics assessment, frequently discussing them in tandem. Participant 8 stated that math instruction and assessment failed to reflect her cultural background and lived experiences when she went to school. She said:

> These tests were not reflective of my culture. You were never asked, you know, what types of games do you play at home? Do you play cards at home? Do you play cards with your family? All these things were never reflected in the way of teaching. It was not reflected in these assessments. They are not culturally appropriate.

In discussing mathematics curricula, Participant 8 underscored the lack of representation, saying, "You never saw yourself in a word problem." Similarly, Participant 1 noted that questions and examples often featured predominantly white, British names, "like Sarah and Jane."

Based on participant responses, it is evident a major flaw with standardized mathematics assessments is that they lack cultural relevance for Black learners. Participants observed that, like math assessments, math instruction often reflects a predominantly Eurocentric approach to the exclusion of Black culture. They noted that this is evident in the stereotypical representations found in math problems and, in some cases, the exclusive use of white names.

Pedagogical Improvements

The third research question focused on identifying pedagogical improvements that could enhance math achievement for Black Nova Scotian learners. Three main themes emerged from participant responses regarding how mathematics instruction can be adapted to support these students better. These themes included building students' confidence to challenge stereotypical and racialized narratives, incorporating their lived experiences and Africentric principles into math teaching, and engaging parents in teaching math to their children.

Math Instruction Should Build Learners' Confidence

Black learners' lack of confidence due to stereotypes and racialized narratives about their math abilities was discussed. Participant 3, a former technology assistant in the Nova Scotia education system, expressed his views on enduring stereotypes in math classrooms and teachers'

opinions of Black students. He stated, “From my experience, I think [teachers] valued students that were white, and they thought they're probably smarter than I was.” Even if Black students excel in mathematics, “teachers have a more fixed perspective or perception about African Nova Scotian students.” Participant 11 agreed, saying, “Generally, Black people are considered to be less intelligent.” Thus, they are expected to do poorly in mathematics simply because they are Black.

Participant 11 shared insights into the impact of teachers' behaviour, expectations, and stereotypical beliefs on their relationship with math. In noting their experiences, they stated, “I can remember specific teachers who met my struggles with this subject with like kind of almost anger. They seemed like mad that I wasn't getting the material or that I didn't seem to be, like, trying enough.” Responding with anger, rather than offering support and understanding, proved detrimental for this student. They said:

> It made me just want to give up. I stopped taking math in like grade 10 or like the soonest you can stop taking math, I stopped taking it. Because I think those reactions…and the pattern in the past, I was like, well, I'm just not good at this. I guess I'm not gonna even try.

This quote demonstrates that teachers' beliefs can significantly influence Black students' confidence, effort, and decision to pursue advanced mathematics in school.

Participant 8 shared a similar experience, wherein her teachers’ beliefs led to internalized beliefs about her math abilities. She highlighted the harmful impact of internalizing thoughts, stating, "Once you think that you suck, you are going to suck for the rest of your life. If you continue to inherently take on that attitude, it can be reinforced every day." Thus, believing that you are not good at mathematics can lead to poor performance in math, creating a self-fulfilling

prophecy that can limit future possibilities ("It is going to limit the options of things that you can do"). Participant 12 also mentioned that a lack of confidence in math can extend to other subjects: "I have encountered children who have lost their self-esteem," leading them to believe they could not learn language arts. She acknowledged the time it takes to build confidence in these students once they think they cannot succeed: "It takes like an entire year to really motivate [them] to know that they're able."

Building confidence in Black students' math abilities is crucial in combatting stereotypical narratives. Participant 8 pointed out, "I do not suck at math because I am Black; I am not just inherently bad at math because I am Black." As many Black students endorse these beliefs, she went on to say:

> I think that it would be about looking at building confidence, being gentle with those who are not getting it early and being gentle with those who have been traumatized and stigmatized by teachers who have inherently told them that they have a mental block with math.

She stated that math struggles must be caught early and rectified because by grade three and four students have already "come to a determination in their minds that they are never going to get this shit," which proves detrimental to their confidence and success in mathematics. Participant 9 also highlighted the importance of building confidence in youth, saying, "If you believe in youth, they will believe in themselves, and then they will believe they can understand it."

Math Instruction Should Reflect Students' Cultural Backgrounds and Lived Experiences

A prominent theme surrounding pedagogical improvements was incorporating students' backgrounds, cultures, and lived experiences when teaching mathematics. All participants noted that these elements are currently absent in Nova Scotia schools and expressed a desire for their

inclusion. Participant 3 emphasized the importance of "coming to know Black students," and Participant 6 noted that "understanding the background of a student is critical." As Participant 2 stated, students can "learn a lot of things if it is linked to [their] background, what [they] already know." Thus, teachers should leverage existing knowledge to "help the child learn a new thing." Drawing on this point, Participant 9 said teachers must not assume that Black students have no prior knowledge and not teach them "like they do not know any better." All students come to the classroom with prior knowledge and experiences.

Participants stressed the importance of culturally relevant approaches when teaching math to Black learners. Showing "knowledge and appreciation of cultural context" (Participant 7), wherein home and community values are recognized, is essential for Black students' success in mathematics. In contrast to Western values commonly held in math classrooms, such as individualism and competitiveness, participants emphasized collaborative and cooperative strategies, which are more reflective of Black culture. These strategies included group work and projects to help one another learn math. Speaking of the need for collaboration, Participant 12 said:

> I don't believe that this is only for the Black students, but mainly because that is the culture. That is what happens at home when cooking; everyone is involved. When it's cleaning, everyone is involved. So, collaboration when mathematics is being learned is very good.

Connecting math instruction to community values was also discussed. Participant 7 gave an example of the Black Nova Scotian community's "strong historical and contemporary connection to masonry," which she said could be used to teach math concepts such as measurement and density. Participant 9 also stated that teachers should "connect with the

industries that [students] are familiar with." For instance, teaching math can be connected to careers like construction and paving. This approach allows students to learn practical math skills, such as providing a quote for a new driveway, rather than just isolated mathematical concepts. Highlighting the importance of connecting math teaching to the Black community, Participant 9 stated, "I am sure I learned a lot in school too, but not as much as I could have potentially learned if they taught it in different ways or more ways that connected with me or my community."

Participants emphasized the success they saw when Africentric principles were integrated into math instruction for Black learners. Participant 10, an educator with experience teaching in Jamacia—which "has the core of Africentricity in its blood"—and the United States, said, "My Africentric way of teaching was valid for my Black students." She observed that using culturally relevant teaching methods resulted in improved math performance in the classroom and higher scores on standardized math tests. Examples included using games, stories, repetition, chanting, and call-and-response to make learning "fun and exciting" for her students. She reported that she observed that some students enjoyed these approaches so much that they played math games at recess and shared them with their parents. She emphasized the importance of providing Black students with strategies that they can own and that align with their culture and interests. This helped her students not just memorize but understand math concepts.

Participant 8 also discussed the positive effects of including Black culture in math education, using a local Africentric math cohort in Halifax high schools as an example. She suggested that math teaching for Black learners should be modelled after it, as it emphasizes collaboration and connection to the community, or "moving together" with others. By incorporating Africentric principles and values, such as working together and playing games,

struggling students in these cohorts mastered math, challenged stereotypes, and gained confidence, resulting in acceptance to post-secondary education. According to this participant, these cohorts are about

> more than just math and numbers. It is about having a different attitude. Having someone empathetic, having someone who [knows] that there is trauma from being told that you just cannot get this because you are not inherently smart at these things. You do not come from people that are smart at math.

Teachers must be invested in understanding the hurt and difficulties Black youth face and the impact on their mathematics performance. All these things should be "taken into consideration when [students] come from a different culture." These successful math cohorts can serve as valuable models for improvement for mathematics educators.

In line with culturally relevant approaches, many participants endorsed that math instruction should apply to Black learners' everyday lives. Noting that not all students are exposed to the same things, Participant 12 stated that the math curriculum and questions must reflect "everyday, real-life questions." Participant 2 agreed, highlighting the impact of using examples that do not apply to students: "If I use an example that [students] are not familiar with, that becomes a problem." Participant 9 discussed the importance of "numbers when it comes to money" but said he did not learn financial literacy in school: "We [learned] fractions and all this stuff that we do not even necessarily use in real life." In line with this, Participant 5 underscored the importance of "meeting students where they are at" and urged math instruction and assessment to be "culturally appropriate and relatable to something that [students] know."

Math Instruction Should Include Parents

Another prominent theme was the involvement of parents in teaching math to Black students. Participants underscored the importance of mathematics for their children's futures, noting it as an essential and core subject. For example, Participant 6 said, "For me, math, science, and English are extremely critical," and Participant 8 noted that not taking math courses in high school "cuts off a lot of avenues" for Black youth. Participant 11 stated that their father's profession as an accountant influenced their interaction with mathematics, leading to a math tutor and "math exercises that were not assigned by the school" to keep them "on track."

Participants indicated the need for inclusion, communication, and resources for parents to help teach their children mathematics at home. Participant 10 stated that parents are children's first teachers: "Students come with a lot. We need to honour that**.** They're coming from homes with parents that have taught them something, [it] doesn't matter what it is. They have taught them something." Learning does not only occur at school. As Participant 12 pointed out, "Learning happens everywhere. Learning happens at home. Learning happens when they are singing." This is why communication between home and school is imperative to students' academic success. If parents know what their children are taught at school, they can help them at home. Noting that students often forget what they learn, Participant 12 suggested weekly or daily newsletters to communicate with parents.

In line with this notion, participants expressed their desire to be more involved in their child's math instruction. Participant 6 mentioned that she felt excluded from her child's learning about partitioning, saying, "I did not know what partitioning is, and you know there is no resource for me as a parent to understand, you know, what is being taught." Due to a lack of resources, this parent felt she could not help her child with this math concept. After teaching

herself about partitioning, she could then teach it to her son. Participant 8 also wished for more parental resources, stating, “Now we have our own generation of kids that we must try to support.” She provided ideas, such as math camps and workshops, that parents can attend to come together to strategize how to support their children best to excel in math.

Math learning extends beyond the classroom and home to the community. Participant 4 pointed out that math can be taught in many places and by many people. Emphasizing the collaborative nature of learning, he said:

> They say it takes a village sometimes. You know your teachers might not be able to help you in the classroom as best as you want them to, but then that's where family comes in or your extended family comes in. Or the neighbour comes in, right? We help each other to learn.

Thus, it is not only the education system that has to teach Black students math; it is everyone’s responsibility.

Participants identified three key pedagogical improvements that could enhance math achievement for Black Nova Scotian learners: building confidence, incorporating culturally relevant instruction, and involving parents. Confidence must be built up to counteract racialized storylines of Black students’ math abilities. Participants noted that low teacher expectations often undermine students' confidence in math, which can hinder their pursuit of advanced math courses in school. A need for culturally relevant math instruction that incorporates students' backgrounds, lived experiences, and culture was emphasized. Participants stressed the importance of integrating Africentric principles into math education and providing collaborative instruction with practical applications to everyday life. Lastly, participants highlighted the role of

parents in facilitating their children's math learning. Parents expressed a desire to be involved in the education process and support their children in developing math skills.

Assessment Improvements

Alongside pedagogical improvements, research question three also explored assessment enhancements to better address the needs of Black learners. Participants emphasized two main themes for revising standardized math assessments. Firstly, assessments should incorporate elements of Black culture, and secondly, they should be more flexible. Similar to math instruction, participants suggested that math assessments should be reformed to reflect Black values and culture. Participant 4 said assessments could be "better tailored to fit and encompass different cultural patterns." In agreement, Participant 11 noted that assessments would be more meaningful if they aligned with students' values, motivations, and identities.

Similarly, Participant 10 underscored the importance of considering what knowledge students bring from home: "What do they come with from an Africentric home that we can use to assess what they know in math?" Students are not siloed; they learn and demonstrate their math abilities in myriad ways. She noted that the pillars of the Black community include "faith, love, and hope," stating that these principles should be considered when determining what students know about math. She wondered, "How can we use those as a concept for math, right? To assess what they actually know. Students come with a lot. We need to honour that."

Because math assessments use a one-size-fits-all approach, another theme was that assessments should be more flexible. Highlighting this need, Participant 6 stated, "There must be different ways of assessing. Just one standardized assessment for all students is not enough." Noting it leaves assessors and educators with only "one perspective," she pointed out that "standardized tests often fail to capture the various ways in which students engage with

mathematics." Participants called for diverse ways of evaluating math knowledge, including observing how students interact in groups and how they work with money. Noting that "sharing is a big part of Africentricity," Participant 10 indicated that math principles, such as division, can be assessed by watching how students share in daily interactions, such as divvying snacks on the playground. She asked, "Why don't we assess a child sharing like a donut, cookies, whatever to really see if they know division?" Other ideas for improving math assessments included evaluating math knowledge in real-time and in small, consistent bits, permitting oral instead of written responses, providing safe spaces for completing math assessments, allowing open book exams instead of requiring rote memorization, and collaborative group projects that extend to real life situations.

An example of flexibility in assessing math knowledge involves considering the whole child. As Participant 12 stated, "A person is vibrant. Learning is not just academic. For the Black person, assessment needs to be wholesome." This involves considering the child's history, family life, discipline, teacher relationships, and interaction with the education system. She also noted the importance of acknowledging the "body, soul, and spirit," mentioning that a positive attitude and motivation can come from religious connections or spiritual aspects of Black culture, things that cannot be measured with standardized tests. Having a more holistic view of Black learners, as opposed to "a small lens of looking at issues," will ensure that other factors hindering academic success are considered.

Participants stressed that mathematics assessments be more flexible and inclusive of Black culture. Educators must acknowledge and honour the knowledge and skills students bring from home. Assessments should also be more holistic, multi-faceted, and reflective of the diverse ways students demonstrate their math abilities.

Discussion

The current study sought to elucidate the unique perspectives and experiences of Black Nova Scotians surrounding standardized assessment practices in mathematics. Findings reveal that Black students and parents perceive math assessments for Black learners as unfavourable for several reasons, including the use of a one-size-fits-all approach, the perpetuation of white values in assessment practices, and the implications of poor performance on Black students' futures. Participants endorsed the need for more culturally relevant and inclusive mathematics instruction and assessment tools for this population. Pedagogical improvements included building confidence to combat stereotypical narratives about Black students' math abilities, incorporating lived experiences and Africentric principles in math instruction, and involving parents in teaching math. Suggestions for assessment improvements also included incorporating Black culture, as well as more flexibility with the assessment process.

This study highlights Black individuals' challenges with assessment practices, a reality supported by the existing empirical literature. Given the underlying flaws with standardized assessments, negative experiences with assessments are understandable for this population. Participants strongly critiqued the one-size-fits-all approach used in math assessments. Supporting this perspective, Davis and Martin (2018) pointed out, "The use of a single form of assessment or a single statistic to describe mathematical ability is limited in explanatory power" (p. 50). The National Research Council (2001) also noted that mathematics proficiency constitutes much more than what can be measured on standardized tests. Similarly, Ladson-Billings (1994) argued that standardized tests do not accurately represent students' academic abilities or what they actually know. In line with this, participants observed that traditional math assessments fail to address the root of students' difficulties, offering limited insights into their

strengths and providing little understanding of why they are experiencing gaps in math content and knowledge. Indeed, most assessments provide snapshots of achievement but fail to capture progress over time, which is at the heart of learning (Pellegrino et al., 2001). Moreover, literacy and language barriers may impact test performance but be unrelated to math abilities. This research highlights the need for a more nuanced understanding of mathematical skills that better accommodate Black students' diverse experiences and abilities.

As indicated by participants, assessment tools are influenced by racist and deficit-oriented views of Black students. Wiliam and colleagues (2004) assert that seemingly neutral assessments are not genuinely objective; instead, they function as “objects of history” shaped to serve particular social agendas (p. 58). Using standardized tests to establish racial hierarchies is not a new occurrence. Historically, test scores have been employed to categorize students by race (Gould, 1995; Tate, 1993), including in mathematics (Davis & Martin, 2018; Wiliam et al., 2004). Black students are frequently portrayed as less capable in math compared to their white and Asian peers (Martin, 2007, 2009). This has contributed to what Martin (2009) describes as a "racial hierarchy of mathematical ability" (p. 297) where Asian and white students are ranked at the top, and Black students are placed at the bottom. Although Asian students generally outperform white students in mathematics, white students remain the benchmark for assessing Black students' success (Davis & Martin, 2018). This is evident in the reliance on white-normed standardized tests to evaluate Black students' math performance.

Poor performance on math assessments has significant implications for Black learners that extend beyond the classroom. Participants noted that low scores on standardized tests often result in Individualized Program Plan (IPP) placement, which can hinder future course selections, university admissions, and career opportunities. Alarmingly, Black students in Nova

Scotia continue to experience disproportionate rates of IPP placement, much like they did three decades ago (BLAC, 1994; NS DEECD, 2016). These ongoing challenges are deeply rooted in the systemic racism and discrimination that affects Black individuals and their communities.

Similar to math assessments, the values and culture associated with whiteness are prioritized in math classrooms (Battey & Leyva, 2016). As Bangura (2012) pointed out, "the history of non-European mathematics is marked by a deep-rooted historiographical bias in the selection and interpretation of facts, and that mathematical activity outside Europe has, as a consequence, been ignored, devalued, or distorted" (p. 8). Thus, approaches to mathematics that do not align with traditional European methods are often overlooked or dismissed. To be deemed mathematically literate, Black students must conform to the math standards set by white students (Martin, 2009). This was clearly illustrated in discussions among participants regarding their children's experiences at school. Teachers considered IPPs for students who used different problem-solving methods than those taught in class. When these students approached math in ways that deviated from conventional methods, their strategies were frequently labelled as incorrect or inefficient, raising concerns from educators about their math abilities.

Participants expressed that math assessment and instruction lack cultural relevance and do not reflect Black students' lived experiences and backgrounds. These observations are consistent with findings from the BLAC report (1994), which highlighted that academic materials are often irrelevant and inapplicable to Black culture. The report also pointed out the scarcity of Black teachers and mentors within the educational system, as well as a lack of representation in both the curriculum and textbooks (BLAC, 1994). Responses from participants suggest that these issues are still apparent in contemporary schools in Nova Scotia. They noted that they rarely see themselves represented in math contexts, curricula, and word problems.

These findings align with a recent review of Black students' experiences in math, which identified several challenges, including racial bias in the classroom, lower expectations from teachers, and limited access to high-quality math instructors, resources, and curricula (Rogers, 2020). These factors hindered Black students' engagement in mathematics. The review emphasized the importance of fostering math engagement from early childhood and providing quality math experiences from an early age (Rogers, 2020), a sentiment also reflected in participants' responses.

Another important factor influencing students' mathematics engagement and success is the role of teachers. Participants reported that their teachers viewed them as less intelligent than their white classmates, leading to differential treatment in math class based on their race. This may reflect unconscious biases teachers hold about Black students. Enrolling in advanced math courses was seen as an anomaly, leaving Black learners feeling out of place, like a "sore thumb." The perception of Black students as exceptional being outside the norm reinforces the stereotype that they are less intelligent and incapable of performing well academically (Ogbu, 2003). Participants noted that educators' perceptions significantly affected their relationship with math and confidence in pursuing advanced mathematics. Teachers' beliefs about students' abilities became internalized, impacting how these students viewed themselves as learners and doers of math.

The impact of teacher beliefs and behaviours on students' academic performance is well-established. Low teacher expectations contribute to poor academic achievement for Black students (Jamil et al., 2018; Vega et al., 2012). Research by Vega et al. (2012) revealed that many teachers in urban schools hold negative beliefs regarding the academic abilities of Black students. In an essay advocating for better instruction for this population, Milner (2011) stated,

“Even when teachers have good intentions, they sometimes do not really believe in the abilities and capabilities of particular students” (p.61). Participants in the current study noted that raising expectations and building confidence would enhance Black students’ motivation and engagement in mathematics. Indeed, Strayhorn (2010) found that Black students obtained higher math scores when teachers recognized their efforts and held high expectations.

Moreover, Young and colleagues (2021) found that mathematics identity—the belief in one's ability to engage with mathematics effectively—was related to persistence and math performance (i.e., GPAs) for Black students. Therefore, if Black students view themselves as capable in math, they are more likely to achieve higher levels of success with the subject (Young et al., 2021). When students receive reinforcement and understand that their success is attributed to their abilities rather than luck or chance, they are more inclined to persist on that path.

Participants resonated with Gay's (2002) view that teaching and assessment must align with "the cultural characteristics, perspectives, and experiences of ethnically diverse students" (p. 106). Integrating culturally relevant pedagogy (CRP) in mathematics instruction is vital to combat oppressive educational practices and close achievement gaps (Ladson-Billings, 1994, 1995). Shifting away from a deficit perspective, CRP asserts that every student can achieve academic success and positive outcomes (Adams & Glass, 2018). Within this framework, the concept of Africentricity in mathematics instruction (Tate, 1995) plays a significant role in the broader movement advocating for culturally relevant pedagogy in mathematics (Ladson-Billings, 1994). CRP and Africentric math instruction are not merely pedagogical methods or tokenistic expressions of Black culture; they actively honour and incorporate Black learners' cultural identities and real-life experiences. These approaches create meaningful connections that bridge

students' prior knowledge with new learning experiences (Ladson-Billings, 1994; Gay, 2002; Hammond, 2015; Tate, 1995).

To ensure Black learners succeed in math, instruction should connect to Africentric culture. Traditional mathematics education for Black students includes rote memorization and repetitive practices, such as decontextualized drill and practice questions (Davis & Martin, 2018; Ellis & Berry, 2005). These narrow instructional approaches result in limited opportunities for higher-order thinking, which can create dependent learners who struggle with real-world applications (Davis & Martin, 2018; Hammond, 2015). Moreover, it can hinder students' ability to pursue advanced math courses, which affects higher education and career opportunities (Flores, 2007; Martin, 2007).

One of the most prominent themes discussed by participants was the importance of incorporating Black culture, values, and lived experiences into math instruction. Cultural values such as cooperation, collaboration, and community were emphasized, along with the inclusion of games, stories, and oral traditions like songs and call-and-response to teach math. The Africentric concept of Ubuntu, which translates to "I am only because you are," was a common topic of discussion, although that specific word was not used. Ubuntu holds great significance in many Black communities and encourages individuals to live lives of compassion, courage, and connection. The concept of working together and supporting each other in learning math reflected this principle and was contrasted with the traditional methods of teaching math in Western schools. Per participants' views, incorporating Black values and lived experiences into mathematics instruction contributes to engagement, achievement, and problem-solving skills for Black students (Corp, 2017; Enyedy & Mukhopadhyay, 2007; Leonard, 2018; Nasir et al., 2008; Tate, 1995).

Another common theme was the importance of involving Black parents in mathematics education. The idea that "it takes a village" to teach math aligns with the concept of Ubuntu in Africentric culture. Numerous studies highlight the positive impact of external support systems, such as parents, extended family, and the community, on math instruction for Black learners (Berry, 2005; Cunningham, 2021; Davis, 2014; Ladson-Billings, 1994). The BLAC report (1994) also emphasized the significance of parental involvement, stating, "Parents should never leave the education of their children up to the school. They should get involved" (p. 329). The need for a comprehensive home-school partnership remains essential for the success of Black learners today, just as it was 30 years ago.

Implications for School Psychologists

The findings from the current study have several implications for school psychologists working with diverse populations in Nova Scotian schools. Most participants reported negative experiences with standardized math assessments within the school system. To improve this situation for Black learners, school psychologists must examine their implicit biases and understand how they affect their practice and interaction with students. They should embrace cultural humility, which involves ongoing self-reflection and awareness of one's own cultural identities and beliefs (Collins, 2018). School psychologists should also build rapport with students and their families, as it is crucial for the effectiveness of white practitioners serving Black students (Aston et al., 2022).

To circumvent issues related to flawed assessment tools, school psychologists must use culturally relevant clinical judgment when assessing Black students (Aston et al., 2022; Graves, 2022). Breaking standardization may sometimes be necessary to allow for culturally competent practices. Moreover, if school psychologists administer tests to students who deviate from the

intended purpose and population, they must communicate these limitations and caution against the interpretation of these findings (APA, 2020).

Given that relying on a single assessment score provides an incomplete picture of a student's abilities, school psychologists must consider information from multiple sources, such as educators, parents, and other important people in the child's life, when assessing diverse students (Benson et al., 2019). Non-discriminatory assessment practices, such as reviewing records, carefully selecting test batteries, examining access to quality instruction, including multiple raters when observing behaviour, and being knowledgeable about a student's culture, help school psychologists make informed conclusions when working with equity-deserving groups (Aston et al., 2022). As such, school psychologists should strive to use multimethod and multisource assessments, as opposed to "one size fits all" approaches, as much as possible (Cadime & Mendes, 2024, p.3).

Based on participant responses about high-stakes testing and IPP placement for Black learners, school psychologists should encourage school staff to include parents as much as possible in the IPP process. Parents of Black learners in Nova Scotia indicated that there is a lack of communication with parents about IPPs, mainly that IPPs were not properly explained to them and that some students were placed on IPPs without parental consent or knowledge (Hamilton-Hinch et al., 2021). Parents should be invited to IPP meetings where the impact on their child's future is explained, and questions can be asked. School psychologists can work with the school team to brainstorm alternative supports instead of an IPP if warranted. This is particularly crucial when engaging with equity-deserving groups in the school system, especially Black Nova Scotians, who are already disproportionately placed on modified curricula (NS DEECD, 2016).

Dynamic and Formative Assessment as a Way Forward

Dynamic assessment (DA) is an alternative to traditional standardized tests that school psychologists can use to support Black students. Since assessment tools were historically built to create racial hierarchies between ethnic groups, it may be necessary to shift away from using standardized tests completely. DA is a form of interactive evaluation designed to assess an individual's learning potential. Unlike traditional, static assessments that focus on what a student has already learned, DA emphasizes how a student learns, given appropriate interventions and support during the assessment process (Lauchlan & Daly, 2023). This method is said to transcend culture, as students are evaluated based on their own performance rather than a normative sample (Feuerstein et al., 1988). This approach offers more equitable evaluation and recognizes and values each student's unique learning path and strengths.

Ideologically, dynamic assessment is close to formative assessment. Black and Wiliam (1998) characterize formative assessment as “all those activities undertaken by teachers and/or by their students [that] provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (p. 7). These modifications aim to work with students to support and enhance their learning. Some describe formative assessment as a process rather than a type of assessment (Frohbeiter et al., 2011). Formative assessment from classroom teachers, in combination with dynamic assessment approaches from school psychologists, as opposed to end-of-year evaluations and standardized tests, may be the most equitable way forward for Black learners. Moreover, ongoing collaboration between school psychologists and educators, school staff, and administration is imperative to ensure the best outcomes for Black youth. Parents of Black learners must also be actively involved in their children’s education.

Limitations and Future Directions

The insights and experiences shared by participants in this study represent a preliminary step in fostering a deeper understanding of the assessment process, which will aid in developing a culturally relevant, Africentric framework for evaluating the mathematical abilities of Black students in Nova Scotia. The term Black is a large category that includes indigenous African Nova Scotians (i.e., descendants of free and enslaved Black Loyalists, Black Refugees, Maroons, and other Black people who make up 52 Black communities across the province who have lived here for more than 400 years) and Black individuals who are newcomers to Canada (i.e., recent immigrants from Africa or the African diaspora). All participants in the current study self-identified as Black but did not indicate which group they belonged to. It is imperative to distinguish between these groups, as they likely have different individual and collective histories. Future research should compare these groups to uncover differences in perspectives and experiences regarding math instruction and assessment.

Black culture is not a monolith. The current study consulted only 12 Black individuals, which is unlikely to provide enough information to inform how Black culture can be integrated into assessment practices. More research with more Black participants is necessary to explore varying perspectives and ensure the assessment process aligns with their cultural contexts and lived experiences. Additionally, involving current educators and students in the Nova Scotian school system in future research could help determine whether these groups differ significantly in their opinions and experiences.

A limitation of this study is related to data collection. Interviews were conducted by one of three research assistants, each with different levels of research experience and interview skills. Consequently, the approach to follow-up questions varied from one research assistant to another,

resulting in inconsistent experiences for participants; not all respondents were asked follow-up questions. Despite this limitation, every participant answered all four core questions relevant to the current study's research aims, providing sufficient data to analyze. Future research could use focus groups or formal follow-up interviews to provide a richer understanding of participants' perspectives on this topic.

Another limitation is the extended timeframe over which participant interviews were conducted, spanning a period of two years. Data were gathered at various stages, potentially introducing inconsistencies due to the evolving context of the participants' experiences. Furthermore, it is important to note that this research is part of a larger study exploring diagnostic assessments in mathematics for Black and Mi'kmaw students in Nova Scotia. Consequently, certain decisions regarding the study's framework and methodology were made collaboratively by the broader research team, which may have influenced the direction of my individual research. Despite this limitation, my internship experience at DBDLI allowed me to validate participant responses and seek clarification if needed. This connection to the community aided in authenticating my conclusions in the current study.

Another limitation of the current study is the terminology used, especially compared to the larger study. During the interviews, participants were asked about "diagnostic assessments," which were broadly defined as measures used to "determine strengths, gaps in knowledge, or possible disabilities related to mathematics skills and content." Despite the definition, there seemed to be varied interpretations of what constitutes diagnostic math assessments among participants. Some participants referenced provincial standardized math assessments, while others mentioned various math tests and other forms of evaluation. It is evident that a clear consensus on what constitutes a diagnostic math assessment was not established. Consequently,

it may be that the conceptualized of standardized assessments in the current study do not map onto the experiences participants spoke of during the interviews. Future research should aim to clarify this term for improved understanding. Future research should also specifically include participants with experience with standardized math assessments administered by school psychologists. A potential research question is: What are the differences in experiences for Black students with standardized academic achievement tests, such as the KeyMath-3, compared to experiences with tests given to all students, such as provincial standardized tests?

Failure to include school psychologists as participants is another limitation of the current study. School psychologists frequently administer standardized math assessments and make intervention recommendations and diagnostic conclusions based on assessment results. While interviewing educators and past students was informative, including school psychologists in future research could provide additive insights into student learning and assessment practices, specifically for equity-deserving groups. Ideally, culturally and ethnically diverse school psychologists could provide more information about the unique considerations and practices that best support Black students in Nova Scotian schools. This information can be used to build more culturally relevant assessment practices for this population. Using the findings from the current study, future research could ask: In what ways are the experiences and perspectives of Black Nova Scotian individuals integrated into the current practices of school psychologists in Nova Scotia, Canada?

Participants highlighted not only the challenges related to mathematics instruction and assessment practices but also the systemic barriers embedded within the education system. According to Grant and colleagues (2022), school psychology research rarely acknowledges the field's impact on maintaining and perpetuating colonist structures. To properly reflect the

experiences of diverse learners, including Black students, there is an urgent need for more research in school psychology that incorporates a wider range of populations. Additionally, a more extensive study should investigate the systemic and institutional patterns that extend from the education system into school psychology training programs and their curricula. Given that most school psychologists are white females and that their training often focuses on Eurocentric content, it is crucial to challenge the prevailing norms of school psychology programs. Integrating critical and social justice theories into these programs is essential to ensure that the culture and lived experiences of Black learners are adequately represented.

Conclusion

Systemic issues continue to impact Black students in Nova Scotian schools. Racism and discrimination are deeply rooted in math classrooms, as well as in assessment tools. These conditions reflect longstanding issues in this province and other parts of Canada. Culture is a powerful force that shapes individuals' worldviews and influences educational environments; it cannot be ignored or bracketed out. Black culture and lived experiences must be brought to the fore so ways of being, doing, and belonging that have traditionally been excluded from mainstream educational settings are identified, nurtured, and used to promote student achievement. In his article advocating for less assessment negligence and better assessment tools, Graves (2022) urged the field of school psychology to "view Black children in a different light" (p. 587). This must go beyond merely having a different viewpoint; Black students must be fully recognized and valued for who they are. They deserve acknowledgment not only for their academic abilities but also for their cultural identities and the richness they bring to the educational landscape.

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Table 1

Participant Demographic Information

Participant	Age	Gender	Race	Profession/Link to Mathematics
1	27	Female	Indigenous Black	Former student in Nova Scotia education system
2	>60	Male	Black	Researcher; Parent
3	28	Male	Black	Researcher; Technology Assistant
4	41	Male	Black	Finance background; Parent
5	24	Male	Black	Former student in Nova Scotia education system
6	38	Female	Black	Researcher; Parent
7	64	Female	Black	Senior Administrator; Parent
8	42	Female	Black	Education Background; Parent
9	32	Male	Black	Business owner; Former student in Nova Scotia education system
10	42	Female	Black	Education Background;

				Researcher
11	23	Non-binary	Black	Former student in NS education system
12	44	Female	Black	Education Background; Researcher

Table 2

Research Questions, Themes, and Text Examples

Research Question	Theme	Text Example
RQ1: Unique perspectives & experiences regarding math assessments	Negative experiences with math assessments	"These assessments just do not help. Looking over it, it might seem that people see where [students] are, but it does not help those experiencing opportunity and learning gaps. It makes it worse for them, as it did for me." –Participant 8
	One-size-fits-all approach	"All students are given the same questions, regardless of their individual strengths and weaknesses." –Participant 6
	Flawed assessment tools	"We can look at that as a tool to actually eliminate some people from going to higher institutes of learning." –Participant 12
	High-stakes testing	"I know a few parents that talk about the challenge that their kids are facing and that they might end up being designated as IPP." –Participant 2
RQ2: Cultural appropriateness of math assessments	Math assessments lack cultural relevance	"I think that cultural identity when I was going to school was not considered in assessments at all." –Participant 1

RQ3: Pedagogical improvements	Building confidence in mathematical abilities	"If you believe in youth, they will believe in themselves, and then they will believe they can understand it." –Participant 9
	Inclusion of Africentric principles and lived experiences	"We must meet [students] where they are at. It is trying to make it, like I said, culturally appropriate and relatable to something that they know." –Participant 5
	Involving parents in mathematics instruction	"They say it takes a village sometimes. You know your teachers might not be able to help you in the classroom as best as you want them to, but then that's where family comes in or your extended family comes in. Or the neighbour comes in, right? We help each other to learn." –Participant 4
RQ3: Assessment improvements	Incorporate Black culture	"What do they come with from an Africentric home that we can use to assess what they know in math?" –Participant 10
	More flexibility in the assessment process	"There must be different ways of assessing. Just one standardized assessment for all students is not enough." –Participant 6

Appendix A: Participant Recruitment E-mail

Subject: Research Participation Request

Dear (Name),

My name is (Research Team Representative), and I am a researcher with St. Francis Xavier University. I am writing you to see if you would be interested in participating in a research study. I, along with the Delmore Buddy Daye Learning Institute (DBDLI), are looking for individuals of Historic Black Nova Scotian community who would like to talk about perspectives in math education. We are working to develop an Africentric framework for math education that can be used to develop more culturally relevant diagnostic assessments in mathematics.

Your participation would involve an interview with me for about 1 hour. If you are interested, please let me know by e-mail at (email) or contact Dr. George Frempong with DBDLI who can also provide you with more information.

Thank you for your consideration of this request,

Kind Regards,

(Research Team Representative)

Appendix B: Invitation to Participate

Title of Research:

Exploring Historic Black Nova Scotian Experiences with Mathematics Assessment

Name of Researchers:

Lisa Lunney Borden, Ph.D., St. Francis Xavier University

George Frempong, Ph.D., Delmore 'Buddy' Day Learning Institute

Conor Barker, Ph.D., St. Francis Xavier University Jeneva Dennis, Student Research Assistant

Invitation to Participate

You are invited to participate in a research study exploring experiences and perspectives on the assessment of mathematics. If, after reading this letter, you agree to participate, please sign the attached consent form.

Purpose and Description of the Research

Working with Delmore 'Buddy' Daye Learning Institute (DBDLI), we aim to better understand the perspectives and experiences of Black Nova Scotians in math education, and assessment practices in particular. We are curious to know how Black Nova Scotians have experienced diagnostic assessments, understanding ways that Black Nova Scotians come to know and understand mathematics, and subsequently identify ways that the assessment of mathematics can be done in more culturally relevant and meaningful ways to support student learning. This information will be used to develop an Africentric framework of mathematics assessment.

What Will be Required of Participants, Including the Time Commitment

As a participant, you will be asked questions about your perspectives on mathematics assessment. This interview will take about 60 minutes in a 1:1 interview with a member of the research team. This interview will be audio-recorded, and then transcribed, and then summarized. You will meet with the research team member to review the transcript summary to make sure it

was recorded correctly. This follow-up meeting will take about 30 minutes. Your total time on the research will be about 90 minutes. You can participate in person, online, or by phone.

Participation is Voluntary; Right to Withdraw Without Negative Consequences

You are free to withdraw from the research at any time without negative consequences. You may signal your intention to withdraw by informing any member of the research team directly. Withdrawal may be done in person, by telephone, by e-mail, or by mail. You have until **July 1, 2023** to withdraw your data. After this point, your data may already be included in reports issued to DBDLI or publicly discussed. If there is something you are concerned about appearing in the data, you may raise this at any time, and all reasonable steps will be taken to ensure the data is reflective of your intent. You similarly have the right to have refuse to answer any questions that you request. You may refuse to answer any questions or refuse to respond in any conversation without having to terminate your involvement in the research project.

With Respect to Potential Benefits and Potential Harms

The anticipated benefit of your participation is to support the research team in developing an asset-based and culturally relevant assessment tool for mathematics. It is not anticipated that you will experience any harm, conflicts of interest, or other ethical difficulties due to participating in this proposed research. There may be harms we do not yet know about, and the research team and DBDLI are committed to assisting you should the need arise.

Confidentiality and Anonymity

Your interview will be recorded and transcribed for research purposes. Transcription will be done by a third-party service (GoTranscript), and analyzed by a student researcher. They will both sign a confidentiality agreement. All information you supply during the research will be held in confidence, and your name will not appear in any report or publication of the research unless you wish to be specifically identified. Your data will be safely stored in a locked facility and on a

password-protected electronic system, and only research staff will have access to this information. Confidentiality will be provided to the fullest extent possible by law. The outcomes of this study will be presented together with other participants to ensure that no individual can be identified.

How Can I Access the Results of the Study?

The results of this study will be documented in two forms: a report written for DBDLI to outline the study's findings and a research article presented publicly. A copy of the DBDLI report will be provided to each participant via e-mail if requested. Please contact Dr. Lisa Lunney Borden at the contact information below if you would like to have a copy emailed to you.

Miscellaneous

Data collected throughout the research process will be stored in a secure, password-protected electronic file for five years after publication which time the files will be deleted.

If, after reading this letter, you agree to participate, please sign and return the attached consent form.

Contact Information Principal Investigator:

Dr. Lisa Lunney Borden, Ph.D. Professor, Math Education

St. Francis Xavier University

lborden@stfx.ca

Appendix C: Consent Form

I have received a copy of the Invitation to Participate for the research project titled *Exploring Historic Black Nova Scotian Experiences with Mathematics Assessment* have had an opportunity to read the information provided or it has been explained to me and have had all questions that I may have had answered.

I agree to participate in this research project, understanding that I am doing so voluntarily, that confidentiality will be maintained, and that I have the right to withdraw from the study at any point using the means outlined in the Invitation to Participate.

Name: _____ Signature _____

Date: _____

Two copies of this form are provided for your completion and signature. Please keep one copy and return the other copy to Dr. Lisa Lunney Borden

Appendix D: Core and Demographic Interview Questions

This is a semi-structured interview; I will start by asking you demographic questions, then I will ask you four core questions, followed by certain follow-up questions if needed. Free feel to pass on any questions you don't want to answer. Any questions before we get started?

Demographic Questions

- How old are you?
- What gender best describes you?
- Do you have an Indigenous identity?
- Are you a member of a visible minority?
- Do you have a disability?
- Are you receiving accommodations for your disability?

Core Questions

1) What is your knowledge and experience with diagnostic assessments used to teach or identify disabilities in math? *(Explain, if needed, that "diagnostic assessments" are used to determine strengths and gaps in knowledge or possible disabilities concerning mathematics skills and content.)*
2) Considering the experience of diagnostic assessments with Black learners (yourself or someone you know), can you describe this experience?
    a. Do you believe your cultural identity, or the cultural identity of the person being assessed, if not you, was valued and honoured during this assessment?
    b. Why or why not?
3) In what ways do you think diagnostic assessments could be more culturally relevant, appropriate, and meaningful?
4) From your perspective, what teaching strategies might be appropriate to support Black

learners to come to know, understand, and conceptualize mathematics?