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A review of research on learning support in mathematics education in Sub-Saharan Africa: The case of Botswana, Namibia, Zambia and Zimbabwe.

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Abstract

All learners have different educational needs, and learners taking mathematics are no exception. This review paper focuses on the recent studies in Sub-Saharan Africa in four countries: Namibia, Botswana, Zimbabwe, and Zambia in mathematics education. These countries perform poorly in mathematics according to all SACMEQ (Southern and Eastern Africa Consortium for Monitoring Educational Quality) reports, though there has been an incremental improvement. The methodology of the study incorporated research studies on mathematics learning disabilities and difficulties, however, only limited research was found in Namibia and none in the other countries using this terminology. In all four countries, the inclusive education policies do not specifically mention MLD. As a result, this study was expanded to include learners' performance in mathematics in general. The articles sought were research-based articles and were mainly empirical for the period 2010 to 2021. Most research focuses on problems related to poor performance of learners, teachers' and learners' perceptions and attitudes, and teacher training in mathematics education. These issues are compared and contrasted in different countries. The limited research found on MLD focuses on beliefs, misconceptions, barriers in teaching and learning mathematics, and learning support. We recommend that in these four countries, more research is needed on learners with MLD within the general mathematics population. The focus area should include early identification of learners with MLD, support based on the diagnosed learning needs, and teacher training on MLD, appropriate teaching and learning strategies.

1. Introduction

Over the past decade, Mathematics Learning Difficulties (MLD) attracted the attention of many researchers and educators, focusing on a better understanding of the construct; however, some African countries are under-represented in such studies. Therefore, this article reviews studies and government documents about learning support in mathematics education in four countries in Sub-Saharan Africa, namely Botswana, Namibia, Zambia and Zimbabwe. These countries were selected since they form part of SADC (Southern African Development Community), whose main objectives are to achieve economic development, peace, security and growth, as well as alleviate poverty, enhance the standard and quality of life of the peoples of Southern Africa and support the socially disadvantaged through regional integration (SADC, 2012). The countries border one another and are among the smaller populations in SADC. In addition, their histories are intertwined with British colonialism, and upon their political independence, English became their official language. As such, their initial education systems after their independence have been largely based on the British education system. This review focuses on mathematics education, specifically MLD and disabilities, in these countries.

A comparative study was undertaken to incorporate previous research studies conducted in these countries. The focus was on i) terminology employed by researchers (in each country), ii) the countries' policies, and iii) empirical research related to MLD and disabilities and inclusive education, which has been conducted in slightly more than the last decade. These issues have been compared and contrasted.

The order of this article is as follows: 1) an introduction to the countries; 2) a comparison structure of education that includes teacher training and mathematics assessment, both locally and internationally; 3) policies on inclusive education and MLD and disabilities; 4) research conducted on MLD and disabilities. The article concludes with an emphasis on the review's findings and suggestions for future studies.

1.1 Introduction to countries

The map of Southern Africa below highlights the proximity of Botswana, Namibia, Zambia and Zimbabwe and the rare, four-nation, purported quadripoint where they meet. Table 1 provides background information regarding the geography and population of the four countries in the Southern African Development Community (SADC) that are discussed in this article.

In Table 1, it is apparent that these four neighbouring SADC countries have a wide range in their populations. Botswana and Namibia have very small populations and, similarly, small population densities, while the Zambia and Zimbabwe populations and population densities are about six times larger.

Figure 1: Location of Botswana, Namibia, Zambia, and Zimbabwe in Africa (Quadripoint, 2022).

Table 1: Introduction to countries.

Countries	Botswana	Namibia	Zambia	Zimbabwe
Population (2 August 2021)	2,401,764	2,590,585	18,938,504	15,096,708
Country size	581,730 km²	825,615 km²	752,614 km²	390,757 km²
Population density	4/km²	3/km²	25/km²	39/km²

1.2 The education structure in general

1.2.1 Education structure in general

Table 2 presents the education systems of the four countries, as well as the Grades in which mathematics is offered as a subject.

Table 2: The general education structure.

		COUNTRIES			
		BOTSWANA	NAMIBIA	ZAMBIA	ZIMBABWE
The education system	School phases	*2½- 6 years early childhood education *Primary School (Grades 1-7) *Junior Secondary Education (Grades 8-10) *Senior Secondary Education (Grades 11-12)	*Pre-primary (Grade 0) *Junior primary (Grades 1-3) *Senior primary (Grades 4-7) *Junior secondary (Grades 8-9) *Senior secondary (Grades 10-11) *Advanced subsidiary (Grade 12)	*Early childhood (3-6 years) *Primary education (Grades 1-7) *Secondary education (Grades 8-12)	*Two years of Pre-primary school (3-5 years) *Primary education (Grades 1-7) *Lower Secondary school Ordinary Level (Forms I-IV) *Upper Secondary school Advanced Level (Forms V-VI)
	School age	6-17	6-18	7-18	6-17
	Learner enrolment	103.2% (2015)	124.2% (2018)	98.7% (2017)	109.8% (2013)
	Learner-teacher ratio	Primary: 25 (2022)	Primary: 25 (2018)	Primary: 45 (2022)	Primary: 36 (2013)
	Medium of instruction (MOI) according to the language policy	Setswana is the MOI in Grade 1 with English as the 2nd language. From Grade 2 this is reversed	Mother tongue (14 languages) from pre-primary to Grade 3 with English as the 2nd language. From Grade 4 this is reversed.	Mother tongue (7 languages) from Pre-primary to Grade 3 with English as the 2nd language. From Grade 4 this is reversed.	Mother tongue (2 languages) from Pre-primary to Grade 3 with English as the 2nd language. From Grade 4 this is reversed.
	National examinations	*Grade 7 Primary School Leaving Examination (PSLE) *Grade 10 Junior Certificate Examination (JCE) *Grade 12 Botswana General Certificate of Secondary Examination (BGCSE)	Grade 11 (NSSCO) and Grade 12 (AS)	Grades 7, 9 and 12	*Grade 7 Certificate *Zimbabwe Junior Certificate, Grade 9 *General Certificate of Education (GCE) at Ordinary Level (O-level) *Zimbabwe General Certificate of Education (GCE) at Advanced Level (A-level)
Mathematics offered as a compulsory subject		From Primary to Grade 10	Compulsory from Pre-primary to Grade 11 Grade 12 (AS) – elective	Mathematics is compulsory (from Primary to GCE)	Mathematics compulsory (from Primary to O-level)

Table 2 indicates that all four countries have a structured, early childhood education system. In Namibia, the Pre-primary class, preceding Grade 1, forms part of the formal school system. Primary education spans Grades 1 to 7. Namibia, furthermore, divides this phase into Junior Primary and Senior Primary. Secondary education from Grades 8 to 12 is structured differently in all four countries. Zambia is the only country where there is no division into different phases. Learners in Botswana and Zambia exit formal schooling with

a national certificate in Grade 12, while in Namibia, this is possible in Grade 11 with a certificate in Ordinary Level and, in Grade 12, with an Advanced Subsidiary Level qualification. Zimbabwe is the only country that has a 13th school year at the secondary level. They also make use of the term Forms rather than Grades. Forms I-IV culminate in a certificate at Ordinary Level, while Forms V-VI provide an Advanced Level certificate.

There is not much difference between the four countries in terms of typical features when it comes to learning conditions. For instance, there are state (public), private and international schools in all countries, with a large number of learners attending public schools. International schools have their academic calendar based on the country of their origin. While all four countries have excellent learner enrollment rates, their learner-teacher ratios differ somewhat. The recommended class size for primary schools in all countries is between 25 and 45, with Namibia having the lowest class size. However, in practice, some classes could have as many as 65 or 60 learners, for instance, in Namibia and Zambia, respectively. Moreover, there are variations in average class size based on regions, especially in Namibia and Zambia. Kekhani-Mhoney from Namibia echoes the findings of Harfitt (2012), who found that learners in large classes do not receive much individual attention from teachers. Individual attention to students is reduced, negatively affecting Botswana's academic achievements (Adeyemi et al., 2003).

Countries with notably widened gaps between rural and urban schools in the proportion of Grade 6 pupils who enrolled late into primary schooling by two or more years are Namibia (20%) and Zambia (19%). The gap in Zimbabwe between urban and rural remains small at 1%. In Namibia, from 2013 to 2019, there has been an average annual growth rate of 9.3% in the number of schools in the country. However, this rate is higher in primary than in secondary schools because, in sparsely populated rural areas, there is usually a high number of primary school learners, but not all learners transition from upper primary to junior secondary. Reasons could be grade repetition and a high drop-out rate. This is the case in Zambia and Namibia. For example, a greater proportion of Namibian Grade 6 learners attending schools located in rural areas tend to repeat a grade than those in urban areas (EMIS, 2019).

The proportion of school dropouts for 2021 in primary school in Zimbabwe is lower at 0.53%, compared to secondary school, which is 4.67%. In comparison, the average dropout rate for Namibia in 2019 was 1.8%. This represents 13,375 learners (out of a total of 756,994 learners), of whom 6,604 (49.4%) are female. The major reason for female learner dropout is pregnancy (23.3%). According to EMIS, this figure could well be higher if schools reliably reported on the incidence of pregnancies. Furthermore, a reasonably large number of learners dropped out because of the long distance between school and home. Some learners were recorded as leaving school for "unknown reasons" (EMIS, 2019).

According to the different Language Policies, the medium of instruction for the Lower Primary phase should be the local languages with English as the second language. The situation is reversed from the Upper Primary phase. It appears that these language policies are likely to be implemented more effectively in rural than urban areas due to learner diversity in the cities and towns. Although the language policies in these countries promote mother-tongue education in the lower grades, not all learners are being taught in their mother tongue. Two factors may contribute to this: (i) learners residing in areas where their mother tongue is not offered as a medium of instruction due to insufficient numbers of learners; and (ii) parents' decision either to collectively introduce a different medium of instruction in a school or to enroll their child in a school with a different medium of instruction. With regard to mathematics, some terminologies are difficult to translate into local languages. This becomes a challenge for learners to learn mathematics with understanding, and it may negatively affect their academic performance in the subject.

In all four countries, mathematics is compulsory in most Grades. In Botswana, it is a compulsory subject up to Grade 10 whereas, in Namibia and Zimbabwe, it is compulsory up to Ordinary Level. In these countries, learners can take Advanced Subsidiary (Namibia) or Advanced Level Mathematics as an elective in their next school year. In Zambia, mathematics is compulsory for up to Grade 12 for all learners.

1.2.2 Teacher training education

Table 3 below presents teacher training, in general, and mathematics education training, in particular, in the four different countries.

Table 3: Teacher training.

		COUNTRIES			
		BOTSWANA	**NAMIBIA**	**ZAMBIA**	**ZIMBABWE**
Teaching Qualifications	**Minimum qualification required**	A 3-year Diploma	A 3-year Diploma	A 3-year Diploma	A 2-year Certificate in Primary or 3-year Diploma in Secondary Level
	Qualification offered	*A 4-year B.ED Degree (Prim/Sec Educ.) A 3-Year Diploma (Primary or Junior Secondary)	A 4-year B.Ed Degree at University Other institutions offer Diplomas in Education	A 4-year Degree and 3-year Diploma	A 3year B.ED Degree (General) A 4-year B. Ed Degree (Honours)
	Minimum training entry requirements to become a Maths teacher	O-Level (BGCSE) or equivalent; should have a minimum of C (60%) in English Language and a minimum of D (50%) in Mathematics and/or Science	AS Level/Grade 12 with a minimum of C (60%) in English and Mathematics	O-level/General Certificate of Education with minimum 45%	O-Level and/or A-Level with a pass in Mathematics (minimum C) 60%
Mathematics education training	**Mathematics education modules**	***Bachelor of Primary Education:*** *Maths Education I, II *Introduction to Numeracy and Science for Teachers *Teaching Number System *Teaching School Mathematics *Geometry for Primary School Teachers *The Use of Technology in Teaching Primary Mathematics	***B.ED (Pre- and Lower Primary) (Honours)*** *Numeracy and Mathematics Education I-III *Learning Support in the Mathematics Classroom ***B.ED (Upper Primary) (Honours)*** *Introduction to Mathematics Education *Mathematics Education I-III ***B.Ed (Secondary)(Honours)*** *Teaching Methods of Mathematics *Statistics for Educators *Educational Research Project in Mathematics	***Bachelor of Education (Mathematics and Science Education):*** *Mathematics Teaching Methods *Mathematics Education Project *Mathematics Education	***Bachelor of Science Education Honours Degree (Mathematics):*** *Theoretical Foundations of Education *Pre-school & Primary School Mathematics Experience *Numerical Methods *Pedagogics in the Teaching Subject (Mathematics)
	MLD training	No MLD training	*Pre-Service: Learning Support in the Mathematics Classroom *In-service training: Learning support training with Learning Support Resource book	No MLD training	In-service training: *Cluster-based support networks for Mathematics teachers. *Teacher capacity building on special needs and learning disabilities. *Subject associations on Mathematics learning disability.
Inclusive education modules offered		No specific module offered on Inclusive Education	*Inclusive Education I (compulsory for all education programmes) *Inclusive Education II offered as an elective for 4th year students as a career specialisation	*Diploma trainee teachers all do Inclusive Education *Degree trainee teachers – depends on the course	*Inclusive Education (compulsory for both Primary and Secondary Teaching training)

Table 3 above indicates that all four countries accept a three-year Diploma as the minimum teaching qualification; however, tertiary institutions also offer a four-year Diploma and four-year Bachelor Degree with Honors for teachers in different specializations. Entry requirements for teacher training vary across the four countries. Most of the programmes offer teaching methods in Mathematics and Mathematics Education modules. None of the countries specifically train in MLD. Only Namibia's B.Ed. Pre- and Lower Primary programmes include a module for learning support in mathematics. Namibia and Zimbabwe provide in-service training for teachers and education practitioners in learning support. It appears that Botswana and Zambia

do not provide training in learning support in mathematics. Inclusive Education, as a module is offered in teacher training in these countries to varying degrees, except for Botswana.

1.2.3 Mathematics assessment

Table 4 presents how mathematics is assessed at school, national and international levels in the four countries studied.

Table 4: Mathematics assessment.

	Countries			
	Botswana	Namibia	Zambia	Zimbabwe
At school level	Quizzes, topic tests, end-of-term tests and mock examinations.	Homework, tests, exams and projects as part of continuous assessment	Test, exams and continuous assessment	Homework, tests, exams and projects as part of continuous assessment
At national level	*National Achievement Tests, Grade 4 *The students only take standardised examinations when they complete Primary, Junior and Senior Secondary School Levels in Grades 7, 10 and 12	*Namibian Standardised Tests (NSAT) in Grades 5 and 7 *National exams for Grades 11 and 12 from 2020 (new curriculum); (previously Grades 10 and 12)	National exams for Grades 7, 9 and 12	National exams: Primary Level Grade 7, Form 4 (O-level) and Forms 5 and 6 (A-Level)
International level	SACMEQ	SACMEQ	SACMEQ, PISA	SACMEQ

Table 4 indicates that assessments in mathematics focus on homework, tests, projects and exams at the school level. National assessments typically comprise examinations at different Grade levels for different countries. Two countries also administer standardised achievement tests, namely Botswana in Grade 4 and Namibia in Grades 5 and 7. All countries have been involved in the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ), which assesses performance in mathematics and reading, at the international level. Zambia has also been involved in the Programme for International Student Assessment (PISA) which assesses scholastic performance in mathematics, science and reading.

Comparison of international assessment (SACMEQ reports)

The Figures below present a closer look at the SACMEQ assessment scores for mathematics. Figure 2 examines the mathematics scores for Grade 6 learners who were assessed, while Figure 3 looks at the mathematics scores for the teachers of these learners.

The domains for the mathematics assessment consisted of Numbers (operations and number line, square roots, rounding and place value, significant figures, fractions, percentages, and ratios), Measurement (related to distance, length, area, capacity, money, and time) and Space-Data (geometric shapes, charts-bar, pie, and line, and tables of data). Eight skill levels ranged from pre-numeracy through emergent-, basic-, beginning-, and competent numeracy, followed by mathematically-skilled, problem solving, and abstract problem-solving.

Both the reading and mathematics data matrices were analyzed using computer software that applied the Rasch Model of measurement. The test items were calibrated by calculating the Rasch difficulty values for each item. In order to ensure that it was fair to compare all countries on the total test score, the correlations between the 'essential' items and all items were calculated in every country, and in all cases, the results were between 0.98 and 1.00. The mean for all SACMEQ countries was set at 500, and the standard deviation at 100.

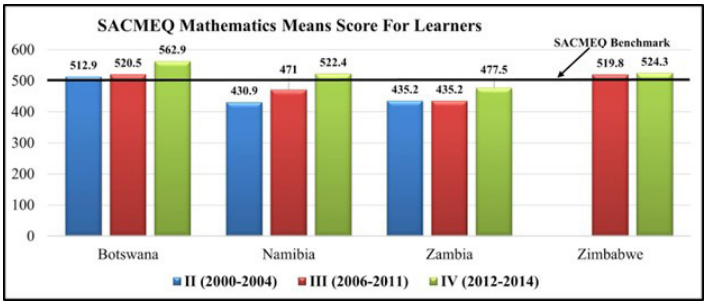

Figure 2: SACMEQ mathematics mean score for learners. Note: SACMEQ mean average 500 (benchmark).

Mathematics assessment did not occur in SACMEQ I; only reading assessment was conducted. Zimbabwe did not participate in SACMEQ II. Figure 1 indicates that the general trend for those countries whose learners participated in more than one SACMEQ, the mathematics scores went upwards. Botswana and Zimbabwe have consistently reached the SACMEQ benchmark; however, Namibian learners have only reached the benchmark of 500 in the 4th assessment, whereas Zambia has not reached this level as yet.

Specifically, in SACMEQ II, the average score for learners in all the countries involved was set at 500. Only Botswana (512) was above that average (Zimbabwe did not participate). The SACMEQ III mathematics average was 510, and Botswana and Zimbabwe were above the average. The average for SACMEQ IV (2013) was 542 points, and once again, Botswana (562) was the only country that surpassed that average.

In SACMEQ II, out of the 14 countries, Botswana was 7th, Zambia was 12th, and Namibia was last in 14th place (Zimbabwe did not participate). In SACMEQ III, 15 countries participated, and Botswana was 6th, Zimbabwe 7th, Namibia was 13th, and Zambia was last in 15th place. Fourteen countries participated in SACMEQ IV, with Botswana in 5th place, Zimbabwe 7th again, Namibia 9th, and Zambia last again in 14th place. Consistently Mauritius and Kenya were first and second across all SACMEQs.

In all SACMEQ mathematics assessments, rural learners fared worse than their urban counterparts in the focus countries. Similarly, the scores of learners with low socioeconomic status (SES) were, on average, way below those having high SES. With regard to differences in gender, the results are mixed. Girls were better than boys in all mathematics assessments in Botswana. In Namibia and Zambia, it was the exact opposite, and boys were better. The one complete Zimbabwe statistics we could access for gender (SACMEQ IV) showed that girls did better than boys.

Figure 2 indicates that, in those countries that participated in the mathematics assessment, teachers scored above the 500 benchmark. Typically, the trend over the years has

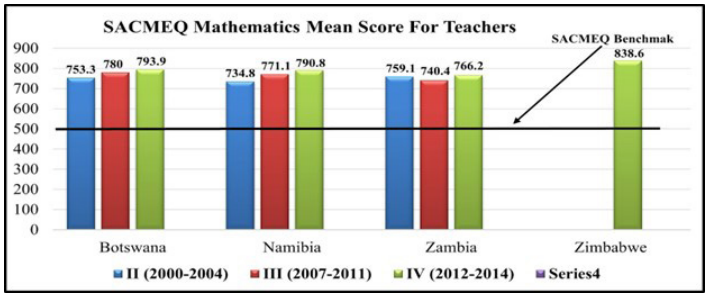

Figure 3: SACMEQ mathematics mean score for teachers.

been upward, although Zambian teachers showed a dip in SACMEQ III. Zimbabwe's first mathematics score for teachers in SACMEQ IV was the highest overall score among the four countries.

According to Gustafsson (2019), international assessment results such as SACMEQ, TIMSS (Trends in International Mathematics and Science Study) and LLECE (Latin-American Laboratory for Assessment of the Quality of Education) are used to inform education policy debates and many times implementation of changes in education, specifically classroom practices. In analyzing the microdata of these assessments, he, however, is of the opinion that the floor effects are not properly taken into consideration, although they (SACMEQ, LLECE) were designed for developing countries. As such, disadvantaged learners who consistently score zero are not sufficiently catered for. To counteract this, he suggests that easier multiple-choice items and more constructed response items should be added to these assessments.

It is these floor effects in these assessments that make them difficult to link and compare in the interest of UNESCO Institute for Statistics (UIS) and World Bank. In addition, comparison of mathematics assessments of the same country but across different grades can also be problematic, especially if factors such as the percentage of out-school-children and grade repetition differ across the grades. Gustafsson (2019) cites Altinok et al.'s (2018) example of Colombia's LLECE 1997 Grade 6 mathematics link to TIMSS 1995 Grade 8 mathematics. A further area of concern was raised in that the original data must truly represent each country. SACMEQ not only assesses reading and mathematics, but goes into much detail in assessing, monitoring and evaluating the conditions of schooling and the quality of education. It is these conditions that make it difficult to compare the mathematics results of an African country to an Asian or European country.

An article by Postlewaite (2004) reviewed the work carried out by the International Association for the Evaluation of Educational Achievement (IEA, with TIMSS and PIRLS), Programme for International Student Assessment (PISA), SACMEQ and LLECE in order to identify their aims and the target populations they used, what they have found about the quality of education in various countries and across time, how they treated the differences in student backgrounds in their analyses, how the results were being used, what impact they were having in the various countries, and finally something about the strengths and limitations of the different studies. The four studies did not compare scores with each other. PISA was for 15 year-olds and the IEA concentrated on the end of primary school so that it could not be expected that they could have a common scale. There could have been a common scale for reading for IEA, SACMEQ and LLECE and this would have enabled the countries to judge how far they were from each other, but since each created scales for their own group of countries this was not possible.

The introductory comparison between the four Sub-Saharan African countries indicates more similarities than differences in terms of their education systems and teacher training, particularly in mathematics (see Tables 1 to 4 and Figures 2 and 3). Based on these observations and in a further investigation of mathematics learning and teaching, this review sheds light on how MLD and disabilities are defined in these countries. Furthermore, it compares the educational support systems of learners with MLD in the inclusive mathematics classrooms of the four countries. Therefore, in the following sections, policies on inclusive education and MLD and disabilities (including assessment and support), as well as the research reviewed (including defining MLD and disabilities and challenges related to MLD and poor performance in mathematics), are presented.

2. Policies on inclusive education and learning difficulties and disabilities in mathematics

The policies on inclusive education in the four countries are rather generalized and focus on learners with learning difficulties (LD) or other forms of disabilities. For instance, the Botswana inclusive education policy generally defines an inclusive education system as one that includes and meets the needs of all learners, including those with special educational needs, and that teachers should be able to meet the needs of such learners in a regular or ordinary classroom (Government of Botswana, 2011; Moswela et al., 2009). Special education needs, of which MLD ought to form a part, are defined as education for disadvantaged and vulnerable learners.

Furthermore, the Namibian sector policy on inclusive education aims to ensure that the education system becomes inclusive, sensitive and responsive to the needs of all children and that all children receive an education. It has a specific focus on children and young people who have been, or are more likely to be, educationally marginalized. These educationally marginalized children may be children with learning difficulties. The Namibian inclusive education policy shifts the focus from blaming the child for difficulties in learning to the interaction between the learner and his/her environment (Ministry of Education, 2013).

In Zambia, inclusive education entails the full participation of all learners in the learning process (Kasongole & Muzata, 2020) since the Ministry of Education's policy aims to allow children with special educational needs to remain in regular schools. It targets marginalized children, such as Learners with Special Education Needs (LSEN), Orphans and Vulnerable Children (OVC), across all education levels (Hamusunga, 2012). In Zambian schools, all learners are taught together and are given the same instruction and

support to meet appropriate learner outcomes (Florian, 1998) because in every class or Grade there could be children with differing educational needs, such as those with difficulties in reading, mathematical calculation and learning new motor skills (Abosi, 2007).

In Zimbabwe, inclusive education is defined as an effort to meet the needs of every child, including those with disabilities, in regular schools (Singh, 2014). The inclusive education policy also addresses and responds to the varying needs of all children by increasing participation in learning and reducing exclusion in and from the education system (Katsande, 2019). Even though the policy requires all learners, irrespective of disability, to belong, participate meaningfully and learn at their local school (Kearney, 2011), this has resulted in the ineffective implementation of inclusive education where learners do not receive the support they require (Chidarikire, 2021).

As can be seen from the discussion above, the inclusive education policies of the four countries are similar in that they strive to include learners, with the support they need, in the least restrictive education environments. These ideals are not always implemented in the manner that the policies recommend. The following sub-sections discuss implementation in terms of assessment and learning support in mathematics.

2.1 Mathematics assessment

There appear to be no clear assessment tools available in MLD in all four countries; however, Botswana and Namibia have what could be linked to assessment tools available in documents (e.g. *Learning Support Resource Book* – Namibia) (Ministry of Education, 2014). The assessment tools outlined in Botswana and Namibia's documents could assist learners with LD and could possibly include MLD. While the documents outline procedures to be followed, the implementation of assessment has been proven by researchers in both Botswana and Namibia to be a challenge.

On the one hand, Botswana has an Assessment Centre that diagnoses the learning needs of learners with special learning needs at primary schools. The Assessment Centre is responsible for placement and/or instructional modification in regular primary schools. However, a study was conducted to investigate the role and functions of the Botswana Assessment Centre in diagnosing learning needs (Mangope et al., 2012). The same study also investigated issues and challenges faced by learners with special needs who are not assessed for placement and/or instructional modification in regular primary schools. The results revealed that the centre was unable to assess all learners who required assessment; furthermore, there was a long waiting time for assessments. The results also revealed that although many schools had School Intervention Teams who were responsible for referring learners for assessment, in some schools, the role of teams was unclear (Mangope et al., 2012)

On the other hand, Namibia, under its Ministry of Education, Arts and Culture, the Directorate of Programmes and Quality Assurance (PQA), is mandated to formulate overall policies for general, formal education, as well as regulatory frameworks and guidelines that support good practices at school and management level. The Directorate has two closely related divisions, namely the Division of Special Programmes and Schools (DSPS) and the Division: Diagnostic, Advisory and Training Services (DATS). DSPS is responsible for the national provision of assistance to educationally marginalized children through special needs education. DATS caters for guidance, counselling and support services, especially for educational, psychological and social assessment. Despite their (DATS and DSPS) mandates, neither division claims to assess specific learning difficulties, such as mathematics difficulties/disabilities, according to the Ministry's website (https://www.moe.gov.na/m_dir_directorates.php – Ministry of Education Arts and Culture, 2018). In a report on *Assessing inclusive education in practice in Namibia* (Nambira et al., 2009), the assessment of learners with specific learning difficulties was not discussed. Learning support was discussed in terms of the placement of learners with disabilities at resource schools and units (former special schools and special units) and learning support classes in mainstream schools (former special classes) but not as a diagnostic process that leads to intervention. Moreover, in the report that focused on learners' performance in mathematics at the Upper Primary phase, the 69 mentions of assessment were solely related to mathematics content performance as related to tests and examinations. The term, intervention, was mentioned only once. As expected, there was no mention in the report of assessment as related to a diagnosis that should lead to intervention.

In a study in Zambia, it was found that several teachers did not seem to know the characteristics of learners with learning disabilities. This failure could make it difficult for teachers to identify and assess learners with LD. As a result, there would be no support for such learners (Kasongole & Muzata, 2020).

In 2003 a standardized test battery for *Basic Numerical and Calculation Abilities* (BANUCA) for Grades 1-4 (n>2600) was published in Zambia. The test is targeted for screening MLD. The Zambian localized version has instructions in English, Chitonga, Cinyanja, Icibemba, Kiikaonde, Lunda, Luvale and Silozi. It was developed and standardized in a project on special education as a product by the Ministry of Education and international partners (Räsänen & Chilala, 2003).

In Zimbabwe, the detection of learners with LD has also not been clearly explained by experts (Mutepfa et al., 2012); however, learners are defined to have LD if they have average and/or above-average intelligence but lag at least two years behind in a subject like mathematics. Some locally produced tests have been utilized in the identification of learners with LD but the authorship is unknown (Kaputa, 2016). There appear to be no clear guidelines on how the identification and assessment of learners with disabilities should be undertaken, except that the Special Needs Education and School Psychological Services will provide staff development in different ways to handle such learners. It would appear that the current aim of assessment of LD (whether it includes mathematics learning difficulties or not) is focused on learner placement rather than on diagnosis and subsequent intervention. The question is, thus, how are

learners with MLD supported in these countries?

2.2 Learning support

Learning support in Botswana, Namibia and Zambia is conducted by class or subject teachers, whether or not they have been trained during pre-service training to offer the needed support. When teachers have not been trained, they can be inducted in ways to support their learners utilising continuous professional development training. Thus, learning support remains the teachers' responsibility.

The inclusive education policy in Namibia recommends that each school should establish Learning Support Groups (LSG). Ideally, at least one Namibian teacher in each school needs to develop some expertise to deal with the more common difficulties and disabilities that learners experience. These teachers would also act as resource persons in their schools. Thus, teachers with expertise in mathematics learning would be the appropriate staff members to lead an LSG that is focused on mathematics learning difficulties.

In Zimbabwe, learning support is offered by qualified, special needs teachers, learner welfare, psychological services and the special needs education department, among others. They build the capacity of other teachers to tackle mathematics learning difficulties, develop appropriate teaching and learning materials for learners with diverse needs and provide advice on learner welfare issues, as well as adapt the general curriculum to meet individual learner needs (Ministry of Primary and Secondary Education, 2021). Mathematics teachers in three of the countries (Botswana, Namibia and Zambia) are required to support their learners with learning difficulties. In Zimbabwe, this responsibility is offered by trained educational practitioners.

3. The research conducted on MLD and inclusive education

This section gives an overview and synthesis of the research on mathematics learning difficulties (MLD) and disabilities in the Sub-Saharan African countries of Botswana, Namibia, Zambia and Zimbabwe.

3.1 Defining mathematics learning difficulties and disabilities

According to Kasongole and Muzata (2020), anyone can learn at her or his own pace and could be intelligent and/or have difficulties in a certain domain. Scholars in the field of mathematics education employ different terms for students who experience difficulties in mathematics, such as mathematics difficulties, mathematics disabilities and dyscalculia, based on the context of their study.

The policies on inclusive education in all four countries under review have not defined mathematics learning difficulties and disabilities (MLD), and there is limited research on MLD. In the Botswanan context, MLD is not defined, although the education of learners with disabilities started more than 40 years ago. Learners with Learning Difficulties (LD) are referred to as those who have mild to moderate intellectual disabilities, mostly found in regular schools. Botswanan teachers sometimes refer to learners with LD as slow learners or underachievers (Otukile-Mongwaketse, 2011).

At the time this article was written, three Namibian studies (Anderson, 2013; Hamukwaya, 2019; Hamukwaya & Haser, 2021) were identified to have employed terms that describe MLD. The three authors employed specific terminology related to mathematics learning difficulties, mathematics learning disabilities and/or dyscalculia in their research by drawing from the definitions of international studies. While these authors provided lengthy definitions of MLD by drawing from the definitions of international experts, none were able to provide a Namibian definition of MLD. Furthermore, Namibian official and unofficial documents that were scrutinized did not reveal any specific definition of MLD. Similarly, a Zimbabwean study defined and employed the term, dyscalculia, but it was not defined in Zimbabwean documents (Mataruse, 2002).

Zambian scholars employed the term 'learning disabilities', and studies of this nature are increasing in their education system (Chirwa, 2011; Muwana & Ostrosky, 2014). LD is defined as heterogeneous in nature, and teachers were still equating definitions of LD to that of physical and other disabilities. They, furthermore, did not demonstrate a basic understanding of the concept (Kasongole & Muzata, 2020). The studies reviewed did not reveal any definition of MLD.

In conclusion, the research studies reviewed employed MLD-related terminologies, but these terminologies did not reflect the current terminologies employed in official policies in their countries. Employing terminologies, such as learning difficulties and learning disabilities when referring to mathematics-related problems, appear to be the more common practice in all four countries. Therefore, this article was expanded to include research focused on problems related to the poor performance of learners in mathematics.

3.2 Challenges related to MLD and disabilities

This section examines the challenges related to MLD and disabilities that yield poor performance in mathematics as indicated by the reviewed literature relating to the four countries. Issues that were discussed by researchers include the lack of mathematical knowledge and skills, teachers' limited understanding of inclusive education, unfavorable teaching and learning conditions and a shortage of teaching and learning materials. Further aspects that came to the fore were curriculum issues, inadequate teacher training, beliefs about mathematics education and learners' interest in learning mathematics, as well as the lack of parental involvement.

Lack of mathematical knowledge and skills. Learners' lack of mathematical knowledge and skills was a common challenge in all four countries. The Examinations Council of Zambia (2018) reports high failure rates related to learners' inadequate understanding and comprehension of mathematical concepts. According to Moyo (2020), Zambian learners who failed to grasp mathematical knowledge and

skills often experienced learning difficulties in other subjects in which mathematical concepts were also employed. A study by Tshabalala and Ncube (2012) reveals that the causes of poor performance in mathematics in Zimbabwean rural secondary schools included a poor grounding in the subject at lower levels. In addition, Namibian research shows that learners who lacked a strong knowledge base were likely to experience MLD in the upper Grades (Hamukwaya & Haser, 2021).

Research also found that some teachers lacked the knowledge and skills needed for teaching mathematics (e.g. Otukile-Mongwaketse, 2011) and they, therefore, found it difficult to support learners with MLD and disabilities. Incompetence in teaching mathematics is believed by Namibian teachers to be one of the factors contributing to MLD that could cause learning problems (Hamukwaya, 2019). Furthermore, some Zimbabwean teachers lacked the appropriate pedagogy to deliver effective teaching due to poor practical instruction (Mupa & Chinooneka, 2015). Similarly, (Mukuka et al., 2020) argue that teachers' instructional and assessment approaches have constrained learners' success in mathematics in Zambian schools.

Teachers lack understanding of inclusive education. Even though the four countries each adopted a policy of inclusive education, they still face several challenges. Otukile-Mongwaketse (2011) looked at how Botswanan teachers implemented inclusive education in their classrooms and what teachers did to differentiate between learners with and those without LD. Findings indicate that learners with LD were not given those learning opportunities that would allow them to participate in the teaching and learning process. According to Morapedi (2018), teachers' understanding of inclusive education does not seem to fit the national requirements regarding the employment of learner-centred learning approaches; furthermore, it appears that they did not accept all learners as individuals. Kasongole and Muzata (2020) acknowledge the presence of Zambian learners with learning disabilities, but posit that teachers did not demonstrate an understanding of the concept despite attending continued professional educational development training. This indicates that learners with learning disabilities did not receive attention in inclusive education classrooms because of teachers' limited understanding of the concept of learning disabilities.

Similarly, some teachers demonstrated negative attitudes towards learners with learning disabilities because they had little knowledge of learning disabilities and, therefore, found it difficult to support those learners (Makamure, 2016; Miyoba, 2014). Consequently, inclusive education is framed rather as a theory than a practice that should be implemented (Chimhonyo et al., 2011).

Unfavorable teaching and learning conditions and environments. Botswana, Zambia and Zimbabwe reveal some teaching and learning conditions and environments that frustrated teachers. For instance, a too-heavy workload and overcrowded classrooms made it difficult to attend to individual learners' needs (Chirwa, 2011; Mukhopadhyay et al., 2012; Muwana & Ostrosky, 2014; Riehl, 2013).

Shortage of teaching and learning materials. There appears to be a shortage of human and teaching resources in Botswana, Zambia and Zimbabwe that obstruct the support of learners with disabilities and hinder the full implementation of inclusive education (Habulezi et al., 2016; Ngulube et al., 2020; Tshabalala & Ncube, 2012).

Curriculum issues. Several curriculum-related factors leading to poor performance and challenges in providing learning support were found in all countries. The literature mentions challenges, such as English as the medium of instruction in Namibia, that makes mathematical word problems, as well as reading questions with understanding, problematic for many learners (Hamukwaya, 2019). In addition, learners in Botswana, Zambia and Zimbabwe experienced learning challenges related to the curriculum because curricula were competitive and examination-oriented (Mpofu & Molosiwa, 2017; Muzata, 2015).

Inadequate teacher training. Research indicates that mathematics education does not receive much attention in Zimbabwe at college level during teacher training; they become mathematics content specialists rather than mathematics education teachers (Makamure, 2016), whereas Zambian pre-service teachers lacked the relevant mathematical knowledge and the mathematical pedagogical knowledge upon the completion of their training (Changwe, 2017). In addition, a Botswana study reveals that special education student-teachers were not prepared to meet the learning needs of different categories of learners with disabilities in an inclusive setting (Moswela et al., 2009). This suggests that these could have been factors that contributed to inappropriate teaching and eventually poor learner performance in mathematics in schools.

Beliefs about mathematics education. The influence of mathematics teachers' beliefs on teaching practice concerning MLD learners was found only in Namibian studies (Hamukwaya & Haser, 2021; Hamukwaya, 2019). Teachers framed MLD within a deficit framework, thus, seeing learners' difficulties as emanating from cognitive disabilities. Some teachers believe that learners cannot perform, they cannot learn in certain settings or that learners' potential to learn mathematics is limited. Teachers believe students with MLD cannot master the expected skills to perform at a certain level or in a certain learning area, and associate MLD with learners' low interest in mathematics. These beliefs illustrate that teachers are unaware of the causes of MLD.

Conversely, Grade 11 Namibian learners were identified as experiencing MLD by their mathematics teachers. Although these learners did not consider themselves as experiencing LD, they recognized that they were not performing well in mathematics. They believed that they lacked high-level access to teaching and learning, which limited their potential for achieving the level at which they were expected to perform and be academically successful (Hamukwaya, 2020). The learners' perceptions were that their learning processes were negatively affected by systemic factors, as well as teachers and learners' personal factors.

Learners' interest in learning mathematics. Research shows that reasons, such as learners' lack of interest in the subject, unwillingness to learn mathematics and the lack of motivation, contributed to MLD and poor performance (Hamukwaya, 2019). In addition, according to a Botswanan study, learners who did not have an interest in the content taught tended to see mathematics as a waste of time (Mosothwane, 2012).

Lack of parental involvement. Studies conducted in Botswana, Namibia and Zimbabwe found that researchers related poor performance to a lack of parental support caused by parents' educational levels and families' socio-economic status (Baliyan et al., 2012; Mupa & Chinooneka, 2015; Neshila, 2018; Sunzuma, 2018). Learners' failure was related to their life experiences, such as low levels of parental education, low socio-economic status and poverty-stricken families and communities (Neshila, 2018). These situations affected parental involvement in supporting learners' learning negatively (Baliyan et al., 2012).

4. Recommendations and conclusion

The four countries face similar problems and challenges that hinder mathematics teaching and learning, especially for learners with MLD and disabilities. The problem of poor performance in mathematics is one of the concerns of teachers and other mathematics educators. In reviewing the literature, the authors concluded that there was a gap in the literature regarding studies that identify the challenges and provide solutions to MLD in the four developing countries of Sub-Saharan Africa. Consequently, more research on issues specifically related to MLD needs to be conducted.

The review points to a mismatch between policy and practice, negative attitudes, unfavorable learning environment and learning content, among others; these were cited as the major disablers to the success of learners with MLD and other disabilities. This state of affairs could be attributed to system failure and failure to implement responsive policies and calls for the effective and systematic monitoring and evaluation of the implementation of these policies.

Despite challenges in implementing an inclusive education policy in schools, the findings of the review indicate that inclusive education is administered alongside the ordinary school system. Governments ensure that learners, despite their learning disabilities, are included in mainstream classrooms. Findings show that the four countries are still not doing well in implementing an inclusive education system. Hence, a recommendation is made that the necessary capacity building for understanding learners with MLD should be provided to teachers to enable them to offer adequate learning support to these learners.

The review reveals that there appears to be no clear definition of MLD and disabilities, as none of the inclusive education policies mentioned MLD. It is recommended that the Ministry of Education in each country defines MLD to create a common understanding of the concept. This understanding could lead to the correct assessment, intervention and support for learners with MLD. Ideally, this definition should be included in official policies, such as the inclusive education policy and learning support documents. Moreover, there is little evidence of assessment tools to diagnose MLD, except in Botswana. Consequently, it can be argued that placing learners in a classroom without understanding and meeting their needs equates to exclusion within the inclusion. This raises the need for studies about MLD assessment, intervention and learning support in these countries.

The concern of teachers or pre-service teachers' lack of mathematical knowledge and skills and learners' inadequate understanding and comprehension of mathematical concepts are among the contributors to learners' poor performance in mathematics. This, consequently, raises a need for educational programmes to strengthen teachers' continued professional training, as well as pre-service teacher training. Lack of teaching/learning competencies may hinder effective mathematics teaching and cause learners to perform poorly.

The literature acknowledges that the personal beliefs of teachers and learners may influence their teaching practices. Research in all four countries has made recommendations regarding the practical implementation of inclusive education that would benefit the learners and lead to subject-specific challenges, such as MLD. Thus, educational programmes need to reshape those beliefs that may hinder effective mathematics teaching and learning. Recommendations in Hamukwaya and Haser's (2021) study advocate that, during pre-service training, teacher education programmes should focus on increasing teachers' awareness of how their knowledge, practices and beliefs about MLD may influence learners to improve their future practices as teachers.

Although the studies reviewed recommend more learning support, researchers fail to specify its application, especially considering the teacher's workload and the syllabus competencies to be covered. Thus, competency-based curriculum assessment is recommended. Furthermore, it is imperative to develop a curriculum that is inclusive for all learners and supports the individual learners' needs in learning mathematics.

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