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Early mathematics learning among naturalised refugee citizens and rural majority and urban majority groups in Tanzania

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Abstract

Globally, available empirical evidence has consistently indicated children of immigrants and refugee backgrounds lagging in most of the developmental indicators and early achievements and learning tests. The developmental and learning disparities are more nuanced in the sub-Saharan region which is characterized by reportedly limited educational resources. This article discusses mathematics learning environments during early years education among naturalized citizens/refugees in Tanzania. Their early mathematics attainments are observed on a benchmark of children from other groups such as urban and rural majorities. The article delineates the role of home learning environments and family socioeconomic status by linking global perspectives and findings from the sub-Saharan region to that from Tanzania. It further discusses the context of early mathematics learning in Tanzania, the existing gap in policy, research, and practice. Challenges facing children of naturalised citizens in learning mathematics within the Tanzanian education system are also discussed. The noted challenges include issues related to curriculum, cultural practices and parental beliefs, mastery of Kiswahili – the official early grades medium of instruction in Tanzania, financing, and quality of early grades mathematics teachers. The article concludes by arguing for improvements in learning experiences of all learners regardless of backgrounds, race, gender, and/or citizenship status. Recommendations for policy, practice, and future research related to children from immigrant and refugee backgrounds are made.

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Introduction

The body of available empirical evidence has consistently indicated that the quality of children's home learning environment and their family socioeconomic status (SES) can adversely affect their development and learning outcomes (Ip et al., 2016; Kiernan & Mensah, 2014; Melhuish et al., 2008). The resulting inequality is said to persist from early childhood to adulthood (Shonkoff & Phillips, 2000). It is reported to have a more deleterious impact on children from poor families who live in rural areas (Ndijuye, 2020). Comparatively speaking, it has an even more severe impact on rural children of immigrant and refugee backgrounds (Koury & Votriba-Drzal, 2014; Kuch, 2017; Ndijuye & Rao, 2018, 2019).

For many decades, early years education researchers have placed great emphasis on the dominant role played by cognitive skills in their research on educational and social inequality (Jones et al., 2015; Koury & Votriba-Drzal, 2014). However, more recent findings have consistently indicated that early academic skills provide a foundation for ongoing engagement in learning throughout schooling (Magnuson et al., 2016), for cognitive skills at the pre-primary and grade one entry levels are strong predictors of later academic achievement (Reardon & Portilla, 2016) and have been found to predict earnings later in life (Heckman, 2011; Heckman et al., 2018).

This study conceptualises children's readiness for school in terms of how well the surrounding environment of children five to eight years of age supports their optimal development and learning. Specifically, the focus is on the development of numeracy skills which align with the existing primary school curriculum. As such, school readiness is expected to broadly promote children's development while simultaneously supporting their respective families (Kagan, 2006; Reardon & Portilla, 2016).

The role of home environments and family SES on children's mathematics attainment

Globally, empirical evidence has consistently indicated linear relationships between home learning environments, family socioeconomic status and children's mathematical skills (Black et al., 2016; Ndijuye, 2020; Reardon & Portilla, 2016). Early mathematics has been proved to be a strong predictor of later academic achievement (Duncan et al., 2007), attention skills (Melhuish et al., 2008), and adult life success (Heckman et al., 2018). In developed countries, research has consistently indicated that children from socio-economically poor and minority immigrant households either come to school with or demonstrate poor mathematical skills (Leyva et al., 2019; Reardon & Portilla, 2016). Little is known in this respect with regard to the sub-Saharan region.

The available cross-cultural studies have indicated that early numeracy experiences at home influence children's acquisition of mathematical skills (Melhuish et al., 2008; Leyva et al., 2019). The learning support noted may be in the form of active parent-child interaction, frequency of engagement, play, the naming of various objects and the

presence of print materials at home (Ip et al., 2016; Melhuish et al., 2008; Ndijuye, 2020). Additionally, the noted aspects help to demonstrate the existing effect size relative to family wealth and socioeconomic status (Ndijuye, 2020). Given the increasing attention paid to the development of early mathematical skills (Leyva et al., 2019; Ndijuye & Rao, 2019), it is important to examine the home context specifically with regard to early mathematics to better understand the mechanisms of development.

In sub-Saharan Africa where there are limited educational resources, the home learning environment and a relatively high family SES are two determinant factors in children's learning and development (Matafwali & Chansa-Kabali, 2017; Ndijuye, 2020). Supportive environments fill the gap left by low-quality schools and teachers (Sumra & Katabaro, 2015; UNESCO, 2020). In Tanzania for instance, children's higher learning attainments have been associated with supportive home learning environments and higher family SES (Kafle et al., 2018; Ndijuye & Rao, 2019; Uwezo, 2020). This is particularly important, and evident, among sub-Saharan children from rural immigrant and refugee communities or backgrounds who are registered at schools with limited educational resources (Kuch, 2017; Ndijuye & Rao, 2019).

Family socioeconomic status is defined by family wealth or income, parental education – especially maternal education, quality and frequency of caregiver-child interaction and parental occupation (Bradley et al., 2001; Ip et al., 2016). Some empirical evidence indicates that, due to the parental stress and hardships associated with economic hardships, children of refugee backgrounds with a lower SES have experienced hostile parenting and poor child management (Kuch, 2017; Mitchell & Kamenarac, 2021). In comparative terms, children from families with a lower SES are less likely to engage in mentally and physically stimulating learning activities such as museum or theatre visits or to benefit from having parental verbal responsiveness, high frequency parental reading and counting of objects available in their surrounding environments, and they are more likely to have poorer physical home characteristics (Engle et al., 2012; Ip et al., 2016; Ndijuye, 2020).

Family SES has been associated with children's cognitive development and mathematical skills (Bradley et al., 2001; Heckman, 2011). Children with a lower family SES have been found to demonstrate poorer cognitive development and mathematical skills than those with a higher family SES (Weiland & Yoshikawa, 2013). The disparities are said to have implications on children's holistic development (Murphy et al., 2018) and income later in life (Heckman et al., 2018). Over the decades, findings from both developed and developing countries have consistently indicated that every increase in family SES results in increased resources and opportunities for child development and learning outcomes (Bradley et al., 2001; Kafle et al., 2018; Lee & Al Otaiba, 2015) and that the impact is greater among immigrant families (Ndijuye, 2020). In developed countries, most of the existing job opportunities are in fields related to science, technology, engineering and mathematics (STEM), but children from lower income and refugee backgrounds are falling behind in STEM-related subjects (Blums et al., 2016). For instance, in the United

States, evidence from various studies (see Blums et al., 2016; Heckman, 2011; Reardon & Portilla, 2016) consistently indicates that the 90/10 income achievement gap has been growing since the 1970s, according to which children from lower-income households score an average of 1.25 standard deviations lower on standardised mathematics tests than those from higher-income households (Reardon & Portilla, 2016). Note that the percentile measures families at the 90th percentile of the national family income distribution against those at the 10th percentile of national family income.

In the sub-Saharan region, and Tanzania in particular, the available empirical evidence indicates that children from lower SES families demonstrate poor learning and developmental outcomes, including in mathematics (Ndijuye, 2020; Rawle, 2015; UIS, 2021; Uwezo, 2020). There are huge gender and urbanicity divides in early mathematics achievement, with urban boys outperforming rural girls by more than 2.3 points of standard deviation (NECTA, 2020; Uwezo, 2020). As far as mathematics learning outcomes are concerned, being a girl from rural Tanzania equates to a double disadvantage. Despite such associations between early SES and later school achievement in Tanzania, our knowledge about how family socioeconomic status (SES) effects are instantiated remains limited.

Education system and provision in Tanzania

The United Republic of Tanzania (URT) follows the 1(2)-7-4-2-3+ formal educational model. This includes one (or two) years of pre-primary education, seven years of primary level education and four years of lower secondary school level education. The pre-primary to lower secondary levels comprise the compulsory component of basic education in Tanzania. The two years at the upper/high secondary level and three or more years at the tertiary level are a necessary element of formal education but they are not compulsory (URT, 2014).

Kiswahili is a medium of instruction in public schools from the pre-primary to the primary school levels, while English is used from lower secondary school on to the tertiary levels (MoEST, 2018; URT, 2014). Given the poor planning of language transition between the primary and secondary school levels (Qorro, 2013) and the poor quality of teachers (Sumra & Katabaro, 2014), there is a sharp decline in secondary students' academic performance. Comparatively speaking, performance is poorer in mathematics among secondary school students (MoEST, 2020) than at any other level of education or in any other field of study.

In 1992, Tanzania formed a national task force for the first time to develop what became the comprehensive Education and Training Policy (ETP) in 1995 (MOEC, 1995). According to this policy, pre-primary education for five- and six-year-olds was attached to primary education and declared the government's responsibility (URT, 1995). The reform sought to increase access to pre-primary education and link it with primary education by requiring that each primary school start a pre-primary class (URT, 1995). While this approach may have increased access to services, the downward extension of primary education negatively affected the

quality of services (Ndijuye & Rao, 2018). Various syllabi catering to this age cohort were developed in 1999, 2000 and 2005, and the state appeared to be trying to catch up with the rest of the world and preparing its young children for the 21st century (URT, 2014).

In 2000, in response to the Education For All (EFA) monitoring report, responsibility for the well-being and education of children from birth to four years was given to the Ministry of Community Development, Gender and Children. Connected to this was the Dakar Framework of Action (2000), which intensified the world movement toward provision of education as a human right. By stressing equitable access to high-quality education, the chances of more Tanzanian children being able to do so, regardless of their backgrounds, increased – at least on paper.

Due to the liberalisation policies of the late 1980s and early 1990s in Africa, the period from 1995 to 2000 saw a decline in public school enrolment due to the introduction of cost-sharing in education (Ndijuye, 2020). Economically better-off parents sent their children to private pre-primary and primary schools, which were equipped with more educational resources. Due to poor physical infrastructure and declining teacher quality, most children, especially in rural areas, were going to school but not necessarily learning at their grade levels (Uwezo, 2010, 2014, 2020). Various studies reported that the majority of children were finishing the primary education cycle without mastering basic numeracy skills (Ndijuye & Rao, 2018, 2019; NECTA, 2020; RTI, 2014; Sumra & Katabaro, 2015; UIS, 2021; Uwezo, 2015) and that some of these semi-illiterate pupils were later enrolled in secondary schools, only to drop out part-way through the school (Sumra & Katabaro, 2015). It was under such circumstances that education stakeholders in the country rallied against the existing policy in favour of a new one that targeted not only broadening educational opportunities but also the quality of those opportunities.

With rapid economic growth and social change in Tanzania and technological advancement throughout the world, by 2010 it was obvious that Tanzania's existing education policy was not bringing about the desired results. As such, educational practitioners started to argue in favour of changing the education policy to meet new demands. In February 2014, the new Education and Training Policy (ETP) was launched for implementation in financial year 2015 (URT, 2014). The new policy seems to target increased access to education without compromising the quality thereof and to focus on issues related to inclusiveness, class size, improved teacher training and attrition (MoEST, 2018). Although children of naturalised citizens are entitled to access to compulsory and free basic education, the performance of this minority group has not been well documented (Kuch, 2017; Ndijuye & Rao, 2018, 2019; Ndijuye, 2020). Data on this subgroup has not even included in the official government's Basic Education Statistics (BEST) until recently (MoEST, 2018).

The existing gap in early grades mathematics attainment in Tanzania

The academic and non-academic achievement gap between children from rich majority and poor immigrant and refugee backgrounds is an area well researched among education scholars (Bethell, 2016; Bradley et al., 2001; Heckman, 2011; Ip et al., 2016; Ndijuye & Rao, 2019). Globally, the mathematics achievement gap is said to start forming even before children begin pre-primary education and persists throughout their academic lifetime and beyond (Bethell, 2016; Han et al., 2012; UIS, 2020). In the sub-Saharan region, even after interventions, the attainment gap widens as children progress to the upper grades (SACMEQ, 2020; Uwezo, 2020). In this region, the most disadvantaged group is rural girls of refugee backgrounds from poor households (Kuch, 2017).

In Tanzania, the mathematics achievement gap among early grades children is one of the least-documented research areas (MoEST, 2020; Ndijuye & Rao, 2019; Ndijuye, 2020; SACMEQ, 2020; Uwezo, 2020). Over the past 20 years, Tanzania has made many efforts to broaden access to basic education (United Republic of Tanzania, 2014; UIS, 2020). However, these efforts have tended not to take account of the quality of education provided, especially for children from marginal groups such as those of refugee backgrounds (Ndijuye & Rao, 2018; RTI International 2020). The most recent independent numeracy assessment tests for early grades children have indicated a sharp decline among children of refugee backgrounds compared to those from non-refugee groups (Ndijuye & Rao, 2019; Rawle, 2015).

Findings by Uwezo (2015 to 2020) indicate that while Tanzania has achieved almost universal access to basic education, most rural children are just "schooling" and not learning to their respective grade levels. For example, in 2020, about 10.1 percent of children aged 5–6 years were not in any form of schooling, even though the official Education and Training Policy requires that all children of this age must be enrolled at pre-primary school level (URT, 2014). About 72 percent of early grades children cannot do word problem subtraction, while for the middle grades this figure is about 43 percent. Similarly, among middle grades children, only 33.4 percent can perform numeracy operations at division level. Surprisingly, among children of refugee backgrounds, about 64 percent in grade four can perform a grade two mathematics exercise, while about 67 percent can perform division-level mathematics.

Generally speaking, early mathematics attainment in Tanzania has been sharply declining for decades (Humble & Dixon, 2017; Ndijuye, 2020; NECTA, 2020; Rawle, 2015) compared to neighbouring countries in the region with a similar socioeconomic status. For instance, the SACMEQ (2020) results show Tanzania's fourth grade children as performing significantly above the 404 averages, but when they are compared to the TIMSS (2011) results, Tanzania's fourth grade children performed far below their fourth grade counterparts in countries beyond the sub-Saharan region, who had between 516 to 600 average points. If one looks closely at their performance against the absolute levels of achievement within the SACMEQ framework, the findings

are even less optimistic.

On average, 44 percent of fourth grade children are classified as innumerate, with this figure rising to more than 62 percent in rural areas. Findings by Uwezo (2020) indicate that in Tanzania, children from upper quartiles of the SES outperform their less advantaged peers by a statistically significant margin. There was a relatively large gender divide in early numeracy learning attainment in Tanzania, with boys outperforming girls (NECTA, 2020; Ndijuye, 2020; Uwezo, 2020). Regardless of cultural differences and parental beliefs and expectations, the gender divide is evident even among naturalised citizens (Ndijuye & Rao, 2019). The reasons for the gender divide in early numeracy attainment are not yet empirically known.

One of the notable challenges facing early numeracy attainment in Tanzania is the quality of the national education system and, therefore, the quality of the country's schools. The key challenge is the limited number of high-quality early grades teachers (MoEST, 2020; Ndijuye & Rao, 2019) and the limited educational resources (Rawle, 2015). The most challenging aspect of the problem is that even the few qualified teachers that are available are concentrated in urban areas (MoEST, 2020). Given that children of refugee backgrounds live and study predominantly in rural areas of Tanzania, this is likely a problem that they face.

Contexts of naturalised refugees/citizens in Tanzania

Since 1961, Tanzania has hosted over 3 million refugees from neighbouring countries (Tanzania Ministry for Home Affairs, 2020). About 300,000 of these have been naturalised as Tanzanian citizens (MoHA, 2020; UNHCR, 2020). Naturalised citizens of refugee backgrounds are mostly from Burundi (82 percent), Somalia (8 percent), the Democratic Republic of Congo (4 percent), Rwanda (2 percent), Mozambique (1 percent) and others (3 percent) (MoHA, 2020). This study will focus on mathematics learning attainment among the children of naturalised citizens of Burundian origin and their families in Tanzania.

Until 2020, there were about 437,140 naturalised citizens of Burundian origin living in Tanzania (MoHA, 2020). They live predominantly in former refugee camps, currently called settlement areas and located in Mishamo, Katumba and Ulyankulu in western Tanzania. The others lead independent lives alongside rural local majorities in the Kigoma region as self-settled naturalised citizens (MoHA, 2020; Ndijuye, 2020). In 2020, about 12,614 of these naturalised citizens were children 5 to 8 years old and registered at various schools for pre-primary to grade two (MoEST, 2020). In the same year, there were 56 qualified early grades teachers working in public primary schools in the settlement areas.

Recent national early numeracy assessment tests (NECTA, 2020; RTI International, 2014; Uwezo, 2020) and empirical studies (Ndijuye & Rao, 2019) in Tanzania indicate that children of naturalised citizens of Burundian origin were not just schooling but learning far better than their rural majority counterparts. Their higher attainment was presumed to be

associated with parental beliefs and expectations (Ndijuye, 2020; Ndijuye & Rao, 2019) and with improved family living standards and SES (Uwezo, 2020).

In Tanzania, existing evidence documents the achievement gaps between rural and urban children (Ndijuye & Rao, 2019; Rawle, 2015; RTI-International, 2014), the genders (Mwaura et al., 2008; Uwezo, 2020) and marginal districts within the mainstream education system (Mwaura et al., 2008; Rawle, 2015). While the achievement gaps among and between naturalised citizens and refugees in the sub-Saharan region are under-studied, to the best of our knowledge there is no single study which focuses exclusively on early mathematics learning and existing gaps among naturalised citizens in Tanzania.

Factors affecting naturalised citizens' early mathematics learning in Tanzania

Curriculum issues

Mathematics learning is a central and fully recognised subject of study in the current school curriculum of Tanzania. It is a compulsory core subject from the pre-primary level – where it is taught in a form of emergent numeracy – to the lower secondary levels (URT, 2014). The importance of mathematics is also reflected in the time dedicated to its teaching, which is comparable to that allocated in more developed systems and, in some cases, exceeds international norms (Bethell, 2016; RTI International, 2020). Over the past 20 years in Tanzania, the mathematics curricula have been revised and modernised as part of broader educational reforms emphasising movement towards competency-based curricular models. In fact, however, early grades mathematics curricular and classroom practices in Tanzania remain largely defined by content and are often delivered by teacher-led pedagogies (Ndijuye & Tandika, 2022).

At the outset, the content of the primary level curricula, for instance, corresponds to widely accepted theories of the development and acquisition of mathematical concepts and appears to be closely aligned with that found elsewhere (Tanzania Institute of Education, 2020). At this level at least, the fundamental problem does not appear to be in the content of the intended curriculum but in its delivery. The available body of empirical evidence suggests that across Tanzania, teachers are failing to help learners grasp the basic concepts of numeracy (see RTI International, 2014, 2020; Uwezo, 2020). This failure has implications for children's learning achievement in mathematics at higher levels (Humble & Dixon, 2017) even later in life.

Further evidence from Tanzania indicates that, beyond the primary level, the current curricula are not well aligned to the needs and abilities of learners from minority backgrounds including the children of naturalised citizens of Burundian origin (Ndijuye, 2020; Uwezo, 2020). As such, the curriculum as delivered is dominated by high stakes requirements and the existing national examinations are used to select students for the next levels and further educational opportunities (NECTA, 2020; Sumra & Katabaro, 2015). In recent grade seven results, which marks the end of primary

education, the failure rates for mathematics when compared to other subjects are extremely high (NECTA, 2016, 2017, 2018, 2019, 2020). These examination results suggest that mathematics teaching strategies are ineffective and perhaps reveal great inefficiencies in the current education system. For example, in Tanzania in 2019, of the roughly 612,000 pupils who sat for the primary school leaving examination in Basic Mathematics, only some 83,000 were successful, for a pass rate of around 13.6 percent (NECTA, 2020). In the same examination, children from rural areas performed much worse than those from urban areas, with only 8 percent scoring a grade B or above.

Cultural issues and parental beliefs

The exceptional gains and effective mathematics teaching and learning found in East Asia suggest that the culture in which teaching and learning take place may offer the most critical explanation as to why some educational systems lag behind (Bethell, 2016). Recent studies have documented the following: societal value attached to education, general perceptions of the difficulty of mathematics as a subject, and parental beliefs and the prevailing view among teachers about the nature of mathematics and how learners acquire true understanding of mathematical concepts (Jerrim, 2014; Lee et al., 2017; Ndijuye, 2020; Weiland & Yoshikawa, 2013). In Tanzania, the general cultural belief about mathematics is that it is a very difficult subject reserved for a few talented learners (Bethell, 2016; Ndijuye, 2020). There are huge gender differences in mathematics learning outcomes, with girls underperforming in examinations across all levels of education due to cultural factors (Ndijuye, 2020; RTI International, 2020; Uwezo, 2020). Various empirical findings suggest that the majority of parents possess culturally conditioned mixed views of mathematics (Mazana et al., 2020; Ndijuye & Rao, 2019).

It is important to note that schools in Tanzania and other parts of the sub-Saharan region tend to reflect the cultural values of the societies they serve. In such contexts, the education of girls is seen as less important than that of boys (Ndijuye, 2020). Given a choice of who to send to school, most of the parents would choose to send their sons due to the lower expectations they have of their daughters. This is a view shared by teachers who, in general, tend to have a better opinion of their male students and, consequently, pay less attention to the girls in their classes (Bethell, 2016; Rabiner et al., 2016). Such prejudice coupled with the low expectations of society has a negative impact on the self-confidence of girls. Sadly, the implications of this for girls' mathematical performance are particularly damaging and on a large scale (Bethell, 2016; Humble & Dixon, 2017; Mazana et al., 2020; Ndijuye & Rao, 2019; Rawle, 2015).

However, among naturalised citizens in Tanzania, the most recent research findings indicate that parents had high regard for education in general and mathematics in particular (Kuch, 2017; Ndijuye, 2020; Ndijuye & Rao, 2018, 2019). Parents regarded education as a pathway to higher social status (Ndijuye & Rao, 2019) and as an escape route from intergenerational poverty (Ndijuye, 2020). As such, they reported employing various strategies to ensure that

their children were not just schooling but learning to their grade levels and beyond. These strategies include sending their children to attend church sermons so as to master the language of instruction, which is different from the official medium of instruction (Ndijuye & Rao, 2019), limiting children's use of vernacular languages at home (Center for the Study of Forced Migration (CSFM, 2008) and added home assignments (Kuch, 2017).

The influence of parental beliefs and expectations on children's early mathematics attainment has been found in other contexts (Lee et al., 2017; Thanh-Pham & Renshaw, 2015). In the United States, children of Asian origin have consistently achieved higher mathematical-learning attainment than the local majorities and other immigrant groups (de Brey et al., 2019; Ng & Wei, 2020; OECD, 2016). Existing empirical evidence has documented the Asian children's higher mathematical attainment, showing the influences of their Confucian heritage culture on parenting (de Brey et al., 2019; Ng & Wei, 2020), behaviour and thinking (Shin, 2012), and teaching and learning approaches (Lee et al., 2017).

Cultural and ethnic differences have been documented as influencing mathematical learning attainment of, among and across immigrant population groups (de Brey et al., 2019; Ndijuye, 2020; Ng & Wei, 2020). While in Europe, immigrant children of Asian origin have not shown any significant differences in early learning attainment compared to other immigrants and/or local majorities (Passaretta & Skopek, 2018), in the United States, they have consistently indicated higher learning attainment from preschool to university (Kim et al., 2016; Ng et al., 2017). Even across the sub-Saharan region, not all immigrant children have demonstrated higher learning attainment than local majorities (Dubeck et al., 2012; Piper et al., 2020). For instance, compared to local majorities, refugee children living in the Kakuma camp in Kenya have demonstrated concerning lower learning attainment. The overall mean score for refugee children was even lower than for children from the disadvantaged Turkana local majority (Piper et al., 2020).

These findings call for active family involvement, including parental beliefs and practices that can positively influence children's learning and development (Garvis, 2021; Selin, 2014). For instance, immigrant Chinese parents in the United States have higher academic expectations of their children to the extent that any score below A+ is mockingly referred to as an Asian F (Ng et al., 2017; Ng & Wei, 2020). Parental beliefs, expectations and involvement have been found to be vital within the context of limited educational resources and large learning disparities across urban-rural, family socioeconomic status and gender divides (Ndijuye & Tandika, 2022) typical of the sub-Saharan region (Bethell, 2016; UIS, 2021).

Mathematics teacher quality in Tanzania

Empirical and grey evidence indicates that effective, high-quality early years mathematics teachers influence children's acquisition of basic numeracy skills (Bethell, 2016; Ndijuye, 2020). However, the data shows that Tanzania faces huge

challenges in attracting sufficient numbers of suitably qualified applicants to train as mathematics teachers (MoEST, 2020). Even those attracted to teaching as a career all too often are said to receive inadequate training and, consequently, enter the profession ill-equipped to meet the considerable demands of the service (Mazana et al., 2020; Ndijuye & Rao, 2019; Rawle, 2015). Poor working conditions (Mazana et al., 2020), low pay and inadequate in-service support potentially result in low levels of motivation and low retention rates among mathematics teachers (MoEST, 2020). For instance, whereas in 2019 there were 6,812 trained pre-primary teachers in Tanzania, in 2020 the number had declined to 6,631 (MoEST, 2019, 2020). In rural regions and districts, the scarcity of high-quality early years mathematics teachers is acute. For instance, in the Kigoma and Katavi regions, which are the regions with the highest number of naturalised citizens, there were only 1,890 trained early numeracy teachers serving 212,888 early grades children (MoEST, 2020). The situation was much worse in schools in rural contexts serving naturalised citizens, where only 44 trained early numeracy teachers were serving a population of 5,289 children (MoEST, 2020).

While there are large numbers of unqualified or less qualified early grades mathematics teachers, the question that comes to mind is do they know enough mathematics to build a solid mathematical foundation for our children? The 2020 report by SACMEQ, of which Tanzania is a member, examined teachers' mathematical knowledge and skills by using a slightly extended variant of the multiple-choice test used for their students. The findings indicated that only 44 percent of the teachers passed the test at the B grade. In other words, more than half of the mathematics teachers were teaching mathematical content that they themselves could not understand. The root cause of the problem has been attributed to the quality of candidates for teaching posts, initial screening and selection, and the quality of pre-service teacher training programmes.

Furthermore, most teachers have consistently reported significant challenges when they try to teach mathematics in the classrooms of Tanzania. In general, the problems identified include poor physical facilities within schools, overly large classes and multi-grade teaching in the primary phase (Bethell, 2016; Ndijuye, 2020), as well as a shortage of textbooks and other teaching resources (Bethell, 2016; UNESCO, 2015). There is, however, considerable variation across the regions. In Katavi region, which has the highest number of naturalised citizens of Burundian origin, 9 out of 10 primary schools do not have electricity, and in Kigoma, the region with the second-highest naturalised citizen population, the child-to-textbook ratio for mathematics is 12:1 (MoEST, 2016). Such problems have implications for the quality of education provided and, inevitably, for children's early mathematics attainment.

The language of instruction policy in Tanzania is of particular importance as each of the 123 ethnic groups has its own vernacular language. After independence, Tanzania – then Tanganyika – radically adopted Kiswahili and English as official languages. In education, Kiswahili was adopted as the medium of instruction at primary school level, while English was kept for the lower secondary to tertiary levels

(URT, 2014). Among naturalised citizens, the language most commonly spoken at home is Kirundi (Kuch, 2017). Children from this group encounter Kiswahili at the classroom door.

Evidence has consistently indicated that children learn basic numeracy skills when taught in a language they understand (Nakiema, 2011; Qorro, 2013; UNESCO, 2015). Where teaching beyond the early years is conducted in an unfamiliar language, “both teachers and learners may often not be fluent enough to use the language as a medium of instruction” (Clegg & Afitska, 2010). This presents considerable challenges to teachers in all subjects, but the problem is exacerbated in mathematics, where both teaching and learning depend on teachers and students understanding the special “linguistic register” of mathematics (RTI International, 2014; Setati, 2002).

Conclusion and recommendations

This article ends with the conclusion that, while early numeracy skills establish the foundations for future mathematics learning attainment in particular and STEM in general, the situation in Tanzania is much in need of improvement. Critical improvements are required among learners who are naturalised citizens, where even mastery of Kiswahili – the medium of instruction – is challenging. Given the critical significance of early mathematics to the future learning attainment and life prospects of the children of immigrants and naturalised citizens in Tanzania, the study makes the following recommendations:

- i. Broadening access to education does not guarantee that children are learning. There is a need to conduct regular tests to find out the extent to which the early grades children of marginalised naturalised citizens and other minorities are acquiring numeracy skills that reflect their grade levels.
- ii. In the context of limited educational resources, the quality of early grades mathematics teachers is of vital importance for children’s development of foundational numeracy skills. There is a need for Tanzania to invest in improving the quality of early grades mathematics teachers heavily and strategically, especially for children from the naturalised citizens group.
- iii. The available empirical evidence documents that children acquire basic numeracy skills better in a language that is spoken at home. Most of the children of naturalised citizens speak Kirundi at home. As such, there is a need to revisit the current language of instruction policy in Tanzania.

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