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# Revisiting the shortage of effective Mathematics teachers in Southern Africa

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In 1996, over two decades ago, as a Mathematics teacher trainer at a teacher training college in then Swaziland, I conducted a study (Luneta 1997) that involved six countries: Swaziland (Eswatini), Lesotho, South Africa (KwaZulu-Natal province only), Botswana, Zimbabwe and Zambia. The survey had two questions for the heads of Mathematics Departments in 10 randomly picked schools from the lists provided by the provincial officials. How many teachers do you have in your department and what are their qualifications? The response sent by post was relatively acceptable at 69%. The outcome was that many schools in Southern Africa, except for Zimbabwe and Zambia, then did not have enough qualified teachers to teach mathematics. The irony, however, was the fact that most mathematics posts in the schools were filled up. Vithal (1992) reported that in South Africa, there was a teacher shortage of between 70% and 90% in mathematics and science within African schools. The failure rate in mathematics in South Africa then was among the highest in the region (Paras 2001). The rate was just as high among the other regional countries. It was therefore prudent to determine the meaning of the Mathematics teacher shortage.

In Luneta (1997), I defined the shortage of Mathematics teachers as the inability to fill up or staff mathematics teaching posts with qualified and certified teachers of the subject. Recently, Sutcher, Darling-Hammond and Carver-Thomas (2019:4) have defined teacher shortages in general as the 'insufficient production of new teachers, given the size of student enrolments and teacher retirements'. It is important to note that the shortage of Mathematics teachers in schools then was not only a Southern African problem, but a problem for the whole world, and it still persists today in 2024. United Nations Educational, Scientific and Cultural Organization (Fiske 2012) asserted that among subjects with a shortage of teachers, mathematics is ranked the highest. I affirmed in 1996 that the shortage came in two main forms as discussed further in the text.

## Shortage because of a lack of experts in the subject

This shortage is when schools lack mathematics-trained teachers, and this fact is acknowledged by the schools and the departments of education. This form of shortage is the most written about as schools report it to ministries of education and is often because of teacher attrition as a result of transfers, promotion and retirements (Wills 2023). The shortage of effective Mathematics teachers is still a concern in schools and highly publicised in research.

## Shortage because of mathematics being taught by non-mathematics specialists

Eggleston & Dunn (1986) identified a 'hidden shortage: where tuition in a subject is given by teachers considered to be inadequately qualified in it or lacking the personal qualities required for effective teaching'. Hidden shortage is a difficult form of shortage to identify and quantify because schools report these posts as occupied despite the fact that the occupants are not mathematics specialists and are often unqualified or under-qualified to teach mathematics.

Another form of hidden shortage of Mathematics teachers is that caused by overcrowding in classrooms resulting in even competent qualified teachers not being as effective as they should be (Wills 2023). Overcrowding results in limited teacher–learner interaction, impacts formative and summative assessments as teachers struggle to mark learners' work on time, and class exercises, homework, remedial and enrichment activities are reduced and often unmarked.

Mathematics teachers who possess limited qualifications and experience in the subject are therefore considered a 'hidden' shortage and these appear in several forms (Ashiedu & Scott-Ladd 2012; Luneta 1997):

- Teachers who are not exposed to Professional Development (PD) programmes because they are not in formal, school, district or government structures, being unlisted in systems and unrecognised are also part of hidden shortage.
- They can also exist as a hidden shortage within the school, communication systems, educational authority and the government. This means that while the teachers turn up in classrooms to teach mathematics, they are not in the normal education chain of interaction and miss out on any forms of PD and communication regarding mathematics instruction and development. Such teachers increase the shortage because they are not recognised as experts in the field, and so may be excluded from career opportunities in mathematics education.

A recent report by Van der Berg, Gustafsson and Burger (2022) shows that South Africa will face a massive shortage of teachers in the next 10 years. In other southern African countries such as Namibia, Botswana, Zimbabwe and Zambia, the shortage is not necessarily in the quantity but the quality of the teachers in relation to their content and instructional knowledge of mathematics (Luneta 2022). Countries such as Namibia, Botswana and Zambia have recently reported excess in teacher output from universities and colleges. Malawi, on the other hand, has experienced a severe shortage of qualified teachers, leading to overcrowding in classroom with a teacher-pupil ratio of 1:130 (Sparkle Foundation 2024). Namibia faces both excess and shortage, with some rural regions experiencing shortages of qualified teachers, while urbanised areas had excess, to the point that the University of Namibia was lauded by the Namibian government for reducing the intake of its education students (The *Namibian* 04 July 2024).

## Identified reasons for the shortage of Mathematics teachers in the region

Research (Du Preez 2018; Van der Berg et al. 2022; Wills 2023) has certified that there are reasons for the shortage of Mathematics teachers in Southern Africa.

### The shortage has also been linked to challenges in replacing retired teachers

In South Africa, nearly half of the teachers in public schools will retire in 10 years' time (Van der Berg et al. 2022); 48% of current teachers are over 50 years old. The rate of retirement is not commensurate to the graduation rate of qualified Mathematics teachers, especially in South Africa. As a result, schools struggle to replace retired qualified Mathematics teachers with new teachers of the same calibre.

### Teaching supply is constrained by slow output from universities

Universities are slow in graduating students in Bachelor of Education and Post Graduate Certificate programmes. A recent Department of Higher Education and Training (DHET) (2022) (South Africa) report pointed out that the graduation rate per cohort is hovering around 57%. This means that university teacher education programmes are not meeting the national teacher demand.

### Not all graduate teachers enter the teaching profession in South Africa

There is a migration of qualified teachers to other countries from South Africa (China, Taiwan, Australia, Seychelles). In 2003, it was reported that South Africa lost 4700 teachers to other countries, mainly to the developed world (Brown 2008). Poor salaries, insufficient classrooms and corruption within the sector are the major reasons for the shortage.

## Addressing the shortage

The impact of the shortage of Mathematics teachers on the overall learning and cognitive development of learners is underestimated by departments of education worldwide. The failure rate is often associated with teachers' lack of content and instructional knowledge and the learners' inability to acquire conceptual as well as procedural knowledge required to excel in mathematics. While both conclusions have been proven to be true, that does not provide the solution to the problem of shortage of skilled Mathematics teachers in schools and how best to address it in order to enhance and optimise learning. Among research-induced solutions are:

- Continuous Professional Development (CPD) programmes for available teachers in schools (Luneta 2012). The programmes must be informed by teachers' content (mathematical knowledge for teaching [MKT]) as well as instructional needs, scalable and sustainable, 'programs that can be enacted in a wide range of local contexts by professional developers other than the program designers' (Koellner, Jacobs & Borko 2011:15). These are programmes that should be carried out by leaders with integrity, content and instructional knowledge of mathematics and are able to adapt it to local contexts, while maintaining consistency with the major benefits of the programme. Koellner et al. (2011) affirm that within the confines of mathematical knowledge for teaching, they expanded the version to include: (1) common content knowledge (CCK), (2) specialised content knowledge (SCK), (3) knowledge of content and teaching (KCT) and (4) knowledge of content and students (KCS) (Ball, Thames & Phelps 2008). Koellner et al. (2011) concluded that PD programmes that support MKT and its offshoots of CCK, SCK, KCT and KCS were found to be effective and sustainable.

In Luneta (2022), I developed what I called the three pillars of standard Mathematics curriculum that could be critical to

**TABLE 1:** Envisaged Mathematics curriculum for effective instruction.

| Three pillars of mathematics curriculum | Mathematics curriculum input by teacher | Mathematics curriculum output by learners | Name of curriculum |
|---|---|---|---|
| Teachers instructions | CK<br>PCK<br>PK<br>CCK<br>SCK<br>MKT | Acquire conceptual + procedural knowledge content + change in behaviour + skills | Teaching and learning in mathematics curriculum |
| Curriculum content | Number + number relationships<br>Functions + algebra<br>Space + shape<br>Measurement<br>Data handling | Mathematical content acquired + change in behaviour, skills + value + use of mathematics | - |
| Assessment | Summative and formative assessment | Learners provide answers as a result Of acquired knowledge + skills | - |

*Source*: Adopted from Luneta, K., 2022, 'Special challenges of mathematics education in Sub Sahara Africa', *Current Opinion in Behavioral Sciences* 48, 101211. https://doi.org/10.1016/j.cobeha.2022.101211

CK, Content knowledge; PCK, Pedagogical content knowledge; PK, Pedagogical knowledge; CCK, Common content knowledge; SCK, Specialised content knowledge; MKT, Mathematical knowledge for teaching.

professional development programmes that address Mathematics teachers' shortage and effective mathematics instruction. Table 1 shows the three pillars of standard Mathematics curriculum envisaged: Teachers' Instruction, Curriculum Content, and the Assessment of the curriculum. The final goal of a good curriculum points to the achievements of the learning outcomes (Luneta 2022:40):

- Establishment of communities of learning among teachers, curriculum developers and subject specialists (Knapp 2003). These communities can develop initiatives to address Mathematics teacher shortages in schools such as rotational teaching, group teaching and school camps, all geared to address effective instruction in disadvantaged schools in the community (Luneta 2012).
- Taking advantage of the Fourth Industrial Revolution (4IR) and its affiliates of Internet of Things, 3-D printing, virtual reality, artificial intelligence (AI), robotics and cloud computing would be pivotal in addressing the shortage of Mathematics teachers in southern African classrooms *(*Engelbrecht, Llinares & Borba 2020). While we acknowledge the digital gap among most schools in the region, I have written somewhere (Luneta 2022:34) that among the offshoots of the 4IR, 'Virtual reality (VR) which is the bringing together of the digital, the physical and biological systems' will probably be the most beneficial in addressing Mathematics teacher shortages in schools because in virtual reality, the reality of anything can be created by the user (teachers) (Cox 2021). The positive aspects of AI, and in this case, the Large Language Models (LLM) in supporting effective instructions in mathematics classrooms should be explored by all ministries of education in Southern Africa in an effort to address the shortage of effective Mathematics teachers in schools.

## Conclusion

After more than two decades, the shortage of Mathematics teachers in Southern African still persists. My concern then is still a live debate and widely researched construct. Overall, the shortage of effective Mathematics teachers in schools in the region has resulted in low conceptual knowledge acquisition by learners and increases in class sizes and teacher–learner ratios.

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