A MISTRA Policy Brief

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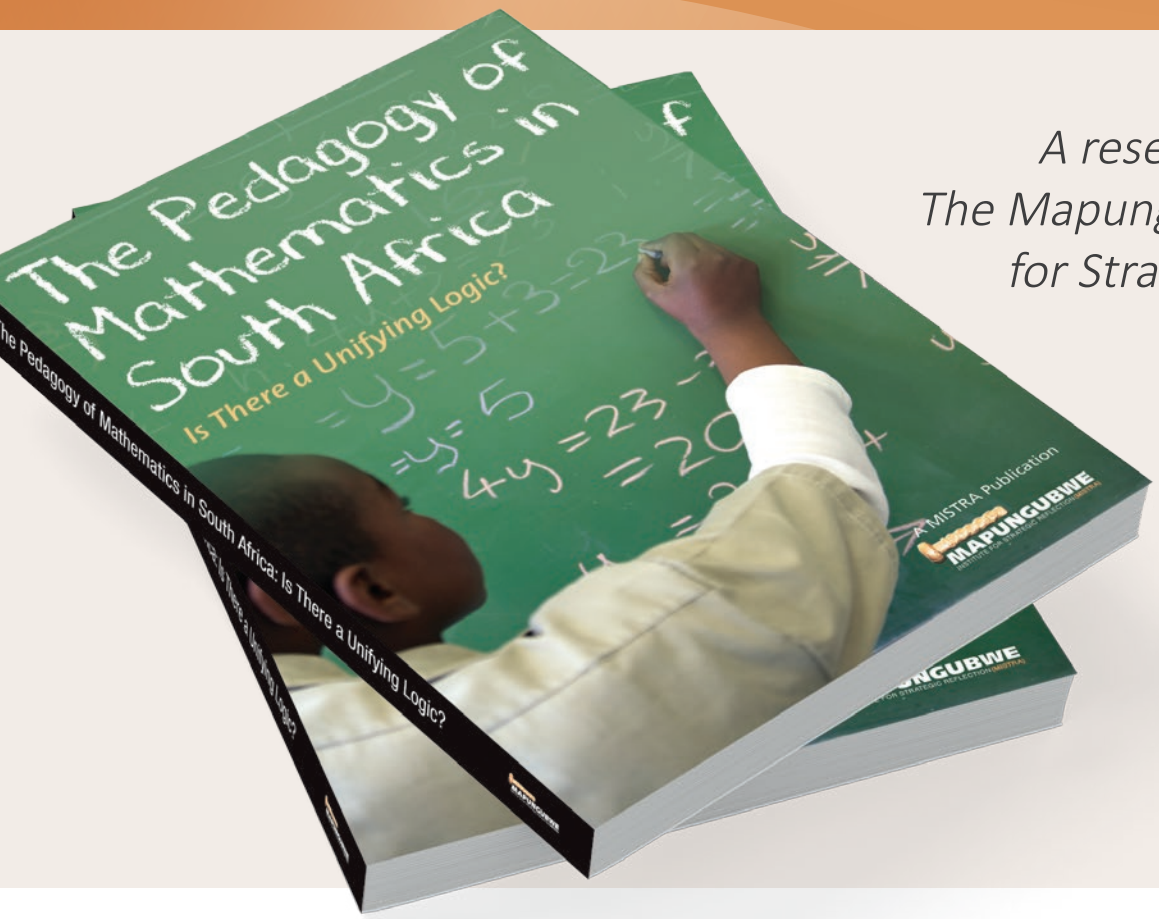

A research project by The Mapungubwe Institute for Strategic Reflection (MISTRA)

The Pedagogy of Mathematics in South Africa:

Is There a Unifying Logic?

Executive Summary

The dire state of mathematics learning in South Africa is a cause for concern. When South Africa is compared on an international scale it falls short by miles. Poor performances in maths and science are a legacy of gross racial, gender and spatial inequalities. In this way education in general and mathematics education in particular becomes a political issue. Methods of teaching mathematics require a constructive relook, at the teacher: learner level. Suitable pedagogies can be built upon the natural cognitive modes of different learners, which are determined by their language, culture and living environments, and these can include creative multilingual presentations. The current education curriculum, Curriculum and Assessment Policy Statement (CAPS), lacks creative aspects and techniques that encompass visual arts and indigenous knowledge systems. At a local school governing body level, there is need for community-based and home-learning initiatives for maths.

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Context

The Trends in International Mathematics and Science Study (TIMSS) in 2003 showed South Africa as being amongst the lowest performers in the world in mathematics and science. The average international score was 467 in mathematics and 474 in science, while South Africa achieved scores of 264 and 244, respectively. Only 14% of Grade 9 South African learners reached intermediate, high or advanced international benchmarks whereas only 17% of grade fives reached these levels. At the Grade 9 level South Africa was ranked 38 out of 39 countries. At the Grade 5 level it achieved a ranking of 45 out of 48 countries.

This crisis has been recognised across the public and private sectors and in broader civil society. As early as 1986 the mathematics education problem was identified by the anti-apartheid National Education Crisis Committee (NECC) and has remained on the public policy agenda ever since. Poor performance is usually attributed to, among other factors, the lower expectations of some teachers, access to textbooks, lack of good educators, inadequate coverage of the curriculum, as well as a host of problems that are identified in earlier grades and are left to compound in later grades. The concern is that with so much attention and spending the improvements have been grindingly slow. This is the common narrative. What, though, is missing from this tale? What is left unsaid?

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Answers also need to be sought in the field of South African mathematics pedagogy. This is what this book seeks to do, with a focus on school level mathematics (Grade R to Grade 12).

The following questions are addressed:

- How has the socio-political history of South Africa impacted on our current self-concept (societal values, attitudes and beliefs) regarding mathematics education?
- Beyond the crisis narrative, which tools and strategies can be employed to improve mathematics education?
- Is it possible for all relevant actors to coalesce around a common vision of mathematics education i.e. a unified pedagogy?

Key Approach

The classical definition of pedagogy is the 'learning and teaching of a subject'. In this instance pedagogy is understood to be the interface between society and its values. Post-apartheid South Africa inherited an unequal system of education which has proved stubborn to eradicate. This socio-political history has impacted its values on the country's educational system. Particularly with mathematics, the vast inequalities show themselves clearly. After all, mathematics education does not take place in a void. The realities of both educators and learners are shaped by socio-political histories whose legacy transcends generations. The confluence between history and the present shapes attitudes and understanding of educators and learners.

The study reflects on these issues, as well as matters to do with language of instruction, awareness and creative utilisation of the social environment, attitudinal factors and the need for ongoing research into the teaching of mathematics. It seeks to create a platform for creative ideas and insights from all South Africans from the community level to the top echelons of public and private institutions. In this context, the insights gleaned are referred to as 'cumulative resonances'.

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Cumulative Resonances

1. **The crisis remains but we are improving.** The recent TIMSS findings position South Africa as the most improved country with a strong positive improvement evident amongst Grade 9 learners from 2003 to 2011, a trajectory that was sustained in 2015. Secondly, the most recent SACMEQ (now SAEQMEC, Southern and Eastern Africa Consortium for Monitoring Education Quality) data show improvements from both learners and teachers.
2. **Debunking the myth that mathematics is for the gifted few:** Mathematicians attach positive connotations to the subject such as 'exciting', 'creative' and 'curiosity'; yet many learners do not. Instead, many believe that the subject is for the 'intellectually gifted'; and the manner in which it is taught reinforces these attitudes and perceptions. The history of elitist access to mathematics, and the employment context requiring mathematics to gain decent work, have major political and socio-economic implications. While education may be used for emancipation, mathematics can be used as weapon to increase and perpetuate inequality.
3. **Mathematics is not fossilised.** Rather, mathematics is a dynamic and changing entity. The knowledge object of 'school mathematics' is not immune to the interplay between history and power. Mathematics is socially and culturally defined, and its position in society can be maintained or shifted by social forces which change over time.
4. **Bolstering support for teachers:** The learning gap between the poorest 60% and the wealthiest 30% of learners in South Africa is about three grade levels in Grade 3, growing to 4 grade levels by Grade 9. The less mathematics that learners know when they come into a teacher's class, the harder it is to help them catch up and move on with the curriculum at the same time. The system does not allow for catch-up and teachers are not supported to do this.
5. **Beyond the role of teachers:** Learners and their parents are central to improving mathematics learning. Learning takes place inside and outside the classroom. Parents need to understand the new approaches and they need to encourage their children to embrace them. Homework drives are one of the ways that all learners can be given an opportunity to independently engage in meaningful mathematical tasks – both during and outside of school time. Where parents are for various reasons unable to do this, other forms of collaborative engagement can be fostered.
6. **Importance of Indigenous Knowledge Systems:** There is a long history of mathematics in different cultures and many studies have shown that various mathematical concepts can be identified in different cultural settings. Teachers are called upon to recognise mathematical concepts, principles and processes in any activity (including indigenous or other community activity) when they see one. This approach would go a long way towards making various mathematical concepts accessible to learners by connecting them to real life socio-cultural experiences.
7. **Language and reasoning matters.** Learners are provided with abstract explanations of mathematical concepts and procedures in language that conflates and conflicts meanings, creating ambivalence and confusion in the usage of specific words. They will thus have difficulties in making sense of mathematical concepts. Mathematical language, like language in general, develops in context to support communication.
8. **Research into the pedagogy and practical teaching of mathematics is critical.** This needs to bring together the community of researchers of maths education, and the aim should include forging a unifying logic to mathematics pedagogy in South Africa. Such logic should bring psychology, sociology and politics into the discourse on the pedagogy of mathematics.

Policy Recommendations

1. **Mother Tongue language as a language of teaching and learning.** Although South Africa endeavours to cater for English Learning Learners, the Language-in-Education Policy (LiEP) emphasises the importance of multilingual education in a diverse society. The underlying principle of the policy is to retain the learner's home language for learning and teaching, but to encourage learners to acquire additional languages as well. Suitable pedagogies can be built upon the natural cognitive modes of different learners, which are determined by their language and culture, and this can include creative multilingual presentations.
2. **Incorporation of creative arts, visuals and Indigenous Knowledge Systems (IKS) in the current Curriculum and Assessment Policy Statement (CAPS).** CAPS is the national policy that guides the subject and learning areas for all subjects in the National Curriculum Statement Grades R –12. Though overloaded, the curriculum is an improvement on previous policies. The overriding concern is that there is no space to interrogate teaching methods, and the measurement of success for learners is narrowly-defined.

   The incorporation of visualisation processes into the practice of any mathematics teacher should be encouraged and promoted more vigorously. Information and Communications Technology (ICT) needs to be used creatively to enhance teaching and learning. The ubiquitous nature of ICT affords teachers the possibility to access teaching resources that harness powerful visualisation and other opportunities that these resources offer. A more transdisciplinary approach in the curriculum can help incorporate the creative arts and other disciplines in mathematics education.

   The National Curriculum Statement for Mathematics and Mathematical Literacy had identified a number of principles, one of which is about valuing IKS and acknowledging the rich history and heritage of all communities. This principle calls upon mathematics educators to have an understanding of Indigenous Knowledge Systems (IKS) broadly and how they can be interpreted and enacted to guide classroom interactions.
3. **Instituting homework drives as school policy.** One of the gaps identified is the need to extend students' opportunities to learn beyond the school day through building mathematics homework into the practices of teachers and learners. The frequency of homework is directly linked to mathematics performance. Aside from supporting performance, homework can have motivational benefits for learners and help learners develop strategies for coping with mistakes and difficulties, and skills in managing tasks independently. Additionally, homework should allow for the consolidation of essential foundational concepts and allow learners to work at differential paces. That would hopefully improve learner motivation, enable stronger mathematical confidence, increased enjoyment of mathematics (which can include oral and dice games) and increased written participation in mathematics.

The MISTRA book containing the research findings and detailed recommendations, entitled The Pedagogy of Mathematics in South Africa: Is there a unifying logic?*, can be purchased from:*
sales@mistra.co.za

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