Improving Maths performance in South Africa's primary schools

Professor Hamsa Venkat holds the SARCHi Research and Development Chair in Primary Maths Education at the University of the Witwatersrand in Johannesburg. She leads the Wits Maths Connect project. The project team works with ten partner primary schools serving disadvantaged student populations, and develops and researches interventions to help teachers improve their students' maths performance. Intervention models and materials with evidence of success are being taken up in provincial and national pilots in South Africa, leading to improvements in both the classroom and teacher education.

South Africa faces a range of social issues including high levels of unemployment, inequality and widespread poverty. The schooling system is dominated by low performing schools with large classes and few resources serving the poor. The schools, teachers and children face substantial poverty-related impediments. Internationally, there is limited research on mathematics teaching and learning among poor and hungry children. Professor Venkat seeks to redress this bias, providing a sense of these on-the-ground realities that have to be taken into account to design substantively useful and pragmatic intervention models.

WITS MATHS CONNECT PROJECT

Professor Hamsa Venkat holds a Research and Development Chair in Primary Maths Education at the University of the Witwatersrand in Johannesburg. She leads the Wits Maths Connect project, which is now in its second five-year phase. The project team works with ten partner primary schools serving disadvantaged students, devising and trialling interventions aimed at improving primary maths performance through a focus on supporting coherent and connected classroom teaching. Intervention models and materials with evidence of success are being taken up in provincial and national pilots in South Africa and beyond, and feed into improvements in both the classroom and teacher education.

PHASE ONE

During the first five years of the project (2011–2015), the researchers worked with the partner schools supporting the development of primary mathematics teaching and learning. One focus was building number sense through working with both teachers and learners in the Lesson Starters Project. The second was the I Hate Maths project aimed at building communities of primary teachers and the public with an interest in talking about mathematics. A 20-day Primary Mathematics for Teaching course was developed, with multiple trials showing robust improvements in primary teachers' mathematical knowledge.

PHASE TWO

The 20-day course and the I Hate Math workshops are continuing through the second phase of the project (2016–2020). Building on the models of the Lesson Starters Project, an additional focus of the second phase is the Seeing Number Structure project which includes workshops and in-class coaching to assist

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teachers to focus their pupils' attention on number relationships and properties, encouraging them to employ strategic thinking with number, rather than relying on counting to solve problems. Another key element in phase two is expanding work on multiplicative reasoning.

THE MULTIPLICATIVE REASONING PROJECT

Research into the educational quality of South African primary teachers' mathematical content knowledge revealed particular weaknesses relating to multiplicative reasoning. Multiplicative reasoning is the understanding and ability to solve mathematical problems involving a multiplicative structure. This includes mutliplication and division problems, but extends to fractions, ratio and proportion situations, and is a fundamental part of mathematical learning.

The Multiplicative Reasoning project builds on the project team's experience of developing interventions to improve the quality of primary maths teaching when working from an evidence base of gaps in teacher knowledge. It aims to address this gap in mathematical knowledge and improve the teaching and learning of multiplication and division across the primary grades.

DEVELOPING THE MODEL

At this level of learning, there is evidence that short sequences of well-structured lessons can have a positive effect. A short-term intervention, comprising four lessons, carefully designed to take into account levels of learning and classroom culture was developed. The pedagogic approach, together with the structure and content of the lessons, are based on the 'Big Books of Word Problems' by Professor Mike Askew, a member of the project team.

The pilot model was designed so that students would be tested before and after the four-lesson sequence in order to provide pre-intervention and post-intervention data on learner performance and their approaches to solving the problems. Weekly training workshops and supported teaching were also provided.

Encouraging results from a series of postgraduate students leading the teaching with single classes led to a scaled-up project with the members of the project team acting as teachers in nine classes of one of the partner schools. A test-teach-test sequence took place with weekly planning meetings with the teachers and research team and also revealed promising results. A further scaling, to involve classroom teachers in all ten partner schools was then designed.

LESSON STRUCTURE

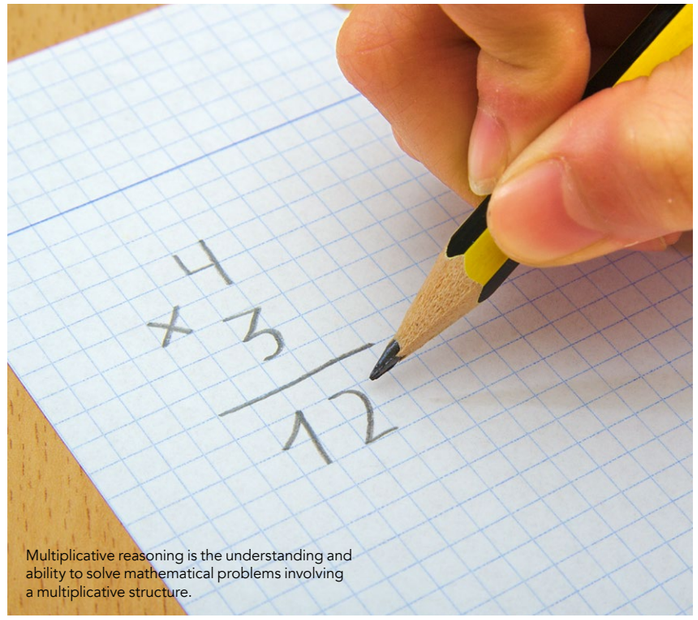
Based on these positive results, a four-lesson model was designed. Each lesson was made up of the following four sections:

1. Revision of multiplication and division facts.
2. Students work in pairs followed by a whole class discussion of three initial problems led by the teacher.
3. Students work independently on six problems.
4. Multiplication and division number sentence examples for independent practice.

The test was made up of 14 multiplicative reasoning problems with five additive reasoning problems, to see how students differentiated between the two.

APPLICATION
The project was then rolled out for all ten partner schools across the Intermediate Phase Grades 4–6. Two grade 7 maths teachers, one from a government fee-paying suburban school and one from a government no-fee township school, also offered to take part in the program. Although both schools serve disadvantaged populations, the suburban school benefited from smaller class sizes and less crowded classrooms. The teachers attended afternoon workshops, led by members of the project team, prior to leading the intervention lessons.

The pre- and post- tests were administered by members of the project team before the intervention commenced and repeated six weeks later. Students were told to answer the questions, choosing the most efficient approach and showing working out where they felt it was required.



Multiplicative reasoning is the understanding and ability to solve mathematical problems involving a multiplicative structure.

RESULTS
The township school started with a lower performance profile than the suburban school. The post-intervention results showed an overall improvement in multiplicative reasoning performance across both schools, with larger improvements in the township school, and prompted a detailed analysis of the learning outcomes of the intervention with these Grade 7 classes. This centred on matching students' pre- and post-tests and analysing the differences in the students' performance on the multiplicative reasoning problems and examining the observed changes in the students' approaches to solving the problems.

The test results reported in a recent paper by Hamsa Venkat and Corin Mathews have shown substantial improvements in the students' ability to use appropriate methods to calculate answers. Students appear to be more able to make sense of the problems through a 'key models and connections' approach.

These results indicate that well-structured short-term intervention models are useful, practical tools for teachers to implement in order to improve their students' performance in multiplicative reasoning tasks. They work without disrupting broader curriculum coverage. The next step is to investigate if the model can work with less input from the project team. A roll-out involving provincial subject advisers working with the intervention material and trialling the model with just one initial workshop for teachers is planned.

WITS MATHS CONNECT RESEARCH AND DEVELOPMENT ACTIVITIES
The Wits Maths Connect project team are involved in a number of other current research and development projects. Provincial initiatives include the Coaching 4 Development course for primary maths subject advisors. This is a 16-day course split across University-based days and lesson observation days. It aims to connect and deepen the subject advisers' mathematical knowledge together with their willingness and ability to have constructive mathematically-focused conversations with primary teachers in order to support teaching development of mathematics.

National initiatives include the Foundation Phase Grade 3 Diagnostic Assessment. This is a three-week test-teach-test diagnostic assessment model with interim teaching activities focused on key mental mathematics skill areas. It aims to use assessment to develop number fluencies and strategies. The project team are working in partnership with the Rhodes Numeracy Chair and the Department of Basic Education on national trials of these assessment tools and teaching activities.

The team members teach and supervise across B Ed, Hons, Masters and doctoral programmes at Wits. They are also involved as partners in the Department of Higher Education and Training Primary Teacher Education (PrimTEd) project which focuses on pre-service primary mathematics teacher knowledge and practice development as well as working with the Department of Basic Education on the development and trialling of national diagnostic assessments for the early grades

Intervention models are useful, practical tools for teachers to implement in order to improve their students' performance.

Behind the Research

Professor Hamsa Venkat and team

E: hamsa.venkatakrishnan@wits.ac.za **T:** +27 (0)117173742
W: https://www.wits.ac.za/staff/academic-a-z-listing/v/hamsavenkatakrishnanwitsacza/ **W:** http://tiny.cc/WMCP

Research Objectives

Professor Hamsa Venkat from the University of the Witwatersrand in Johannesburg focuses on improving primary maths teaching and learning.

Detail

Professor Hamsa Venkat
Wits Maths Connect Corridor
Marang Block
Wits School of Education
St Andrews Road
Parktown
Johannesburg
South Africa

Bio
Professor Hamsa Venkat holds the NRF/FRF SARCHi Research and Development Chair in Primary Maths Education at the University of the Witwatersrand in Johannesburg. Her current work focuses on primary mathematics teaching and learning development. Previously, she was a mathematics teacher in London, before obtaining a BERA-award winning PhD from King's College London and moving into teacher education at the Institute of Education.

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Research Team
The research and development work of the Wits Maths Connect – Primary project are supported by a team of staff and postgraduate students: co-Project Managers, Dr Samantha Morrison & Corin Mathews, Wits Distinguished Scholar, Prof Mike Askew, and team members: Dr Lawan Abdulhamid, Herman Tshesane, Marie Weitz, Sameera Hansa, Thulelah Takane, Dr Lynn Bowie and Lincoln Lavans.

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Personal Response

What are your plans for future research in developing primary maths performance?

" Promising results have led to provincial, national and international interest in the intervention modes and materials that have been developed in the Wits Maths Connect – Primary project. We are currently building a longitudinal analysis of improvement in the sophistication of children's approaches to solving number problems in the context of our development work. The linked research and development activity has been powerful for producing evidence-based models and materials that policy-makers and researchers can take up and trial. Over time, we feed into better understandings of how to address and improve primary mathematics learning outcomes for children in contexts of disadvantage. "