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. 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 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 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 multiplication 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 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.

These on-the-ground realities have to be taken into account to design substantively useful and pragmatic intervention models.
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.

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 Hansa Venkat and Corin Mathews have shown substantial improvements in the students’ ability to use appropriate tools for teachers to implement in order to improve their students’ performance.

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