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Grade 10 mathematics teachers' discourses and approaches during algebraic functions lessons in Acornhoek, rural Mpumalanga Province, South Africa

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ABSTRACT

The purpose of the current study was to gain insights into the mathematical discourses and approaches of Grade 10 teachers during algebraic functions lessons within rural classrooms. The study focused on five rural teachers from the Acornhoek region of Mpumalanga Province of South Africa, to investigate their classroom discourses and approaches to algebraic functions, and the factors that influence their teaching of the topic. The teachers were purposefully and conveniently selected. In this study, all four components of algebraic functions: linear, parabolic, exponential, and hyperbolic functions were used as units of analysis to illuminate their discourses and approaches during teaching. Sfard's (2008) commognitive theory was referred to, with particular focus on characteristics of the mathematical discourse: word use, visual mediators, endorsed narratives, and routines as theoretical framing for the study. In addition to this, Scott, Mortimer and Amettler's (2011) pedagogical link-making (PLM) framework and communicative approach framework were used to identify and discuss the nuances of teachers' practices during algebraic function lessons.

The study adopted a qualitative research approach and used semi-structured interviews, non-participant classroom observations and video-stimulated recall interviews (VSRI) as methods of data generation, with an adoption of descriptive and interpretive elements of data analysis. A case study of each teacher revealed the teachers' thinking and communication about the concept of algebraic function. The main research question for the study was: "What are the rural Grade 10 teachers' discourses and approaches during algebraic functions lessons?" The findings emerging from this study are categorised into three broad themes and sub-themes. The first theme is 'Teachers' use of functions representations and their weaknesses' and has two sub-themes: 'Functions as drawing graphs: rituals to reach the end goal' and 'Multiple problems, assumed instruction for mathematical action'. This theme focuses on the teachers' use of rituals in using the different modalities of representations during teaching, which illuminate the teachers' thinking about algebraic functions to be about drawing graphs, which in turn results in the under-teaching of the related concepts as prescribed in the curriculum documents. The second theme, 'Teachers' communication about the effect of parameters' reveals teachers' use of mathematical discourses and approaches to algebraic functions to bring the notion of the effect of parameters to the fore, for students to understand the effect of changing the values of parameters on the four different families of algebraic function. This theme is divided into three sub-themes: 'Generalising from worked examples', 'The participationist approach to generalisation' and 'The use of examples: variation between parameters'. The first sub-theme addresses the nature of the classroom environment that was created by the teachers for learners to learn about the effect of parameters. The majority of the teachers employed exposition teaching strategies to talk about the effect of changing the values of parameters on the functions, without allowing learners to explore

the relationships for themselves and construct mathematics meanings as advocated by the curriculum principles (Department of Education, 2011). The second sub-theme details how one of the teachers created opportunities for learners to participate in learning, explore and observe the effect of varying the parameters and making their own meanings about the different families of functions. The third sub-theme focuses on how teachers selected and sequenced examples for the different families of algebraic functions in an attempt to illuminate the effect of varying the values of the parameters on the behaviour of the functions.

The third major theme 'Approaches to teaching functions' focuses on the two approaches that were predominantly used by the participants: the use of examples versus non-examples and the property-oriented approach. These approaches are discussed in relation to the identified discourses in the first two themes. The last major theme 'Factors that shape rural teachers' approaches and discourses' draws mainly from the comments teachers made during VSRIs to present reasons as to how and why they taught mathematics, especially algebraic functions, the way they did. Three reasons were given for using authoritative/non-interactive communicative approaches during teaching and for the observed under-teaching of the topic. The first factor, 'The discourse of teaching for compliance', represents teachers' reasons why they did not allow for participatory discourse to enable learners to be active co-constructors of mathematical knowledge as they feared that such strategies would delay them from reaching the teaching goals detailed by the subject pacesetters. The second sub-theme, 'Teaching for assessment' focuses on teachers' observable actions linked to preparing learners for possible assessment questions, to enable them to answer questions correctly. During VSRI, teachers commented that they taught learners for assessment purposes such that when the learners performed well, the department would not put them under surveillance. Lastly, 'Knowledge of Algebraic Functions and curriculum focus' details teachers' limited knowledge of the curriculum standards and content knowledge for algebraic functions, which resulted in the under-teaching of the topic. I believe that expanding the research locale for mathematics education in South Africa to focus more on rural areas and schools can offer insights into the nature of teaching and learning in those contexts, and can help us to configure strategies to promote effective mathematics in those areas.

Key words: Algebraic functions, discourses, approaches, rural, mathematics, teaching, mathematical discourses