The nature and quality of the mathematical connections teachers make

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Current reforms in mathematics education emphasise the need for pedagogy because it offers learners opportunities to develop their proficiency with complex high-level cognitive processes. One has always associated the ability to make mathematical connections, together with the teacher's role in teaching them, with deep mathematical understanding. This article examines the nature and quality of the mathematical connections that the teachers' representations of those connections enabled or constrained. The researchers used video recordings of four Grade 11 teachers as they taught a series of five lessons on algebra-related topics. The results showed that the teachers' representations of mathematical connections were either faulty or superficial in most cases. It compromised the learners' opportunities for making meaningful mathematical connections. The researchers concluded by suggesting that helping teachers to build their representation repertoires could increase the effectiveness of their instructional practices.

Introduction

Developed and developing countries, including South Africa, have revised their mathematics curricula in recent years to take account of what they regard as the knowledge and skills learners require to participate in a globalising twenty-first century world.

There seems to be some agreement that higher order cognitive skills and processes are necessary for more equitable educational outcomes and economic productivity (Muller & Subotzky, 2001).

However, the major challenge has been how to convert this noble vision from the written into the taught curriculum.

The problem

In South Africa, there has been general public discontent about learners' actual gains in knowledge and skills despite the steady increase in pass rates since the advent of democracy. Muller (2005) questioned the credibility of senior certificate pass rates given the opinion that standards have actually dropped:

> The really invisible outcome, invisible to school educators, that is though not invisible to employers and university admission officers, was that the schooling system was emitting a cohort or two which had reduced opportunities to demonstrate higher-level cognitive skills, had possibly not even been taught them and, in far too many cases, therefore did not have them. (p. 43)

This quotation raises two critical concerns:

- that standards have actually dropped despite the upward trend in pass rates
- that low-level cognitive skills were intentional or unintentional threats to the social and economic health of the nation.

Lubisana (2005) and Edwards (2010) made similar observations about the low cognitive demand of mathematical activities and recommended that researchers do more to understand the specific cognitive levels in the intended, the tested and the implemented curriculum.

It is from these observations and recommendations that the researchers saw a potential gap in knowledge. With specific reference to classroom practices (the implemented curriculum), this article raises the question of the extent to which high school mathematics teachers are creating opportunities for learners to acquire cognitively demanding mathematical connections to use in problem solving situations.

The researchers' entry point to this is by conceptualising mathematical understanding. Whilst acknowledging that there is no consensus about the meaning of 'understanding', Barmby, Harries, Higgins and Suggate (2009) suggest three perspectives that the researchers found relevant for taking their ideas forward.