What are the mathematical literacy processes that prospective mathematical literacy teachers in teacher education programmes at North-West University in South Africa and at Brock University in Canada engage in?

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Introduction

The paper describes learning experiences in terms of possible mathematical literacy processes that in-service teachers in the Advanced Certificate in Education ACE (Mathematical Literacy) teacher education programme at the North-West University in South Africa, and pre-service teachers in the Mathematics teacher education programme at Brock University in Canada engage in during their training. The suitability of mathematics for upper secondary school has been subject to much debate in education. In the Mathematics education arena, the question is asked whether the school Mathematics curriculum is really preparing learners to meet their needs. Educators argue for mathematics programmes that target the needs of both university and non-university bound learners. New courses or subjects focusing on new Literacy's in mathematics which emphasize the ability to know and apply mathematics in one’s everyday life abound. Following these new courses, concerns arise. How and in what ways Mathematics teacher education programmes can provide opportunities for learning mathematical literacy and pedagogy? Registered teachers in the mentioned two programmes are confronted with the challenge of dealing with Mathematics teaching and learning within the mathematics modules.

Mathematical Literacy was implemented in 2006 in South African schools which necessitated the re-skilling of teachers for this new subject. In Canada Mathematical literacy is viewed as very important and pivotal for the workplace and everyday life. The Mathematics for Work and Everyday Life courses and Applied Mathematics courses in Canadian schools can be seen as the counterparts of Mathematical Literacy, in South African schools.
Purpose
Although Mathematical Literacy is a new subject in the South African school curriculum for the Further Education and Training band, a variety of research has already been done in this field: These studies (Brown & Schäfer, 2006:46; Vithal, 2006:38; Frith & Prince 2006:55) envisage modelling, research tasks and project work as possible approaches to teacher education. However, little research has been conducted to ascertain how a training programme for teachers, who are enrolled in these programmes, should be rolled out. The purpose of this paper is to explore the mathematical processes that the registered in-service teachers at the North West University and the pre-service teachers at Brock University in Canada employed during the time of their study although the entire study was an exploration into the practises of Mathematical Literacy teachers at the two mentioned universities. The research question therefore was: Can we as developers of teacher training programmes for Mathematical Literacy teachers in South Africa learn from the teacher training programmes for similar subjects in Canada in order to improve our own programmes?

Literature Review
The question “Where is the reasoning and problem solving?” (Venkat, 2009:1) is a significant and thought-provoking question. Taking a closer look at the National Curriculum Statement (DoE, 2003) and the PISA Assessment Framework (OECD, 2003) one discovers that these two documents have much in common. In fact, the assessment taxonomy for the assessment of Mathematical Literacy was based on the PISA (2003) report as well as the TIMSS report (2003)

Extant literature (DoE, 2003:42; Niss, 2004:91; Pugalee, 1999:20; DoE, 2008:8; De Lange, 2004: 77; Thompson, 2007:195) put an emphasis on teachers being able to solve problems because the very nature of Mathematical Literacy implies a strong claim on problem-solving as the subject is focussed on the solving of problems in real-life situations as well as simulations of real-life situations. It must be noted that a competency, like problem-solving, includes most other competencies like communication, representation, connections, use of aids and tools, argumentation as well as reflection (DoE, 2008:8).
The question must be asked as to what extent Mathematical Literacy teachers are being prepared to facilitate problem-solving in Mathematical Literacy teacher education programmes. This leads to the question whether problem-solving is implemented in practise. Van der Walt (2006:172) answered this question when she found that both the pre-service teachers and the in-service teachers do implement problem-solving but the in-service teachers failed to focus explicitly on the steps and strategies for this important mathematical process.

The question ‘How do prospective teachers in Mathematical Literacy teacher education programmes experience the wordier problems?’ becomes increasingly important if one takes into consideration the fact that Mathematical Literacy is all about mathematics in context according to the National Curriculum Statement (DoE, 2008:7): When teaching and assessing Mathematical Literacy, teachers should avoid teaching and assessing mathematical content in the absence of context.

Bowie and Frith’s findings (2006:34) have real implications for an effective Mathematical Literacy teacher education programme: Prospective teachers in an effective mathematical literacy teacher programme should pay attention to the integration of Mathematical Literacy with other subjects as well as the development of all the important skills and mathematical processes that come into play when Mathematical Literacy is taught to learners.

In South Africa, this task is compounded by the fact that the teachers involved generally had no prior mathematics teacher education which could have provided these teachers with opportunities to learn how the mathematical processes or skills should be focussed on in the curriculum.

What Moodley (2008:70) found in his study is indeed surprising as Mathematical Literacy learners are supposed to outperform Mathematics learners when it comes to reasoning, as they are reasoning (or are supposed to reason) when solving problems in real-life or simulated real-life situations. The question must be asked to what degree the teacher in the study was aware of the fact that reasoning as skills should be focused on explicitly when Mathematical Literacy is taught? Could it be that the mathematical processes are not sufficiently
emphasised in the National Curriculum Statement for Mathematical Literacy (DoE, 2003)?

**Methodology**

Within the qualitative research approach I decided on the multiple case study research design, because of the dual contexts of the study: This study comprised of two contexts because it occurred at two universities in two countries, namely the Canadian context (registered pre-service teachers at Brock University in Canada) and the South African context (registered in-service teachers at the North-West University in South Africa).

Data was collected from the questionnaires completed by 61 of the 189 teachers enrolled in the South African programme and 12 of 30 students enrolled in the Canadian programme. The responses to the questions from all 61 questionnaires that were received back from the South African participants as well as the 12 questionnaires sent back to me by the Canadian participants via e-mail were typed up in a MS Word document of 33 pages and a 29-page MS Word document.

**Findings**

The question regarding the role of mathematical processes in the teacher education programmes was very well responded to by the Canadian participants (11 of 12), while only 27 of the 61 South African participants responded to this question. Six of the 11 responses by the Canadian participants and 12 of the 27 responses by the South African participants indicated that sufficient emphasis was placed on mathematical processes in the programme, but also that 4 of the 11 responses by the Canadian participants indicated that some of the processes were left out in the programme. It is noteworthy that one participant indicated that not only should these processes be mastered by the participants, but the strategies of teaching them to the learners should also receive attention. Four of the 27 responses by the South African participants also indicated that they were empowered by the mathematical processes. Teacher students struggled with
applying the mathematical processes in the class work activities. Of the five processes which are dealt with in MLED 574, viz. Problem-solving, Communication, Reasoning and proof, Connections and Representation, problem-solving is the process that the teacher-students are most familiar with. They regard it as the process of finding the answer to a word problem. The mathematical processes have a large role to play in any mathematical literacy curriculum and should be explicitly mentioned in the National Curriculum Statements and not only be implied as is currently the case. From the empirical data it appears that sufficient emphasis is placed on the mathematical processes in the different mathematics courses in Canada and these processes are explicitly stated in the curriculum documents for all mathematics courses in Canada. In South Africa though, it appears that these processes are not coming to its full right in Mathematical Literacy classrooms as teachers are not very aware of these processes. From extant literature, it appears that no explicit focus is placed on mathematical processes in the National Curriculum Statement (2003) for the South African subject Mathematical Literacy. Problem-solving, Reasoning, Communication, Connection and Representation is only implied in this document.

**Recommendations**

Mathematical processes should be included in the curriculum document of any mathematical literacy curriculum so that teachers could focus explicitly on firstly using these processes themselves, and secondly, use them in teaching learners how to use the mathematical processes in order to develop mathematical literacy in learners. To engage meaningfully in a real-life situation that is mathematically based, requires the application of mathematics content knowledge which could only be gained through these processes.

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