LIKE A PERSON TRYING TO CATCH SOAP BUBBLES: PRESERVICE TEACHERS’ STRUGGLES WITH MATHEMATICS LITERACY

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Tucked away in a single line in the South African government policy document controlling teacher education is a phrase requiring teachers to be numerically literate. This has serious implications for teacher education curriculum developers at universities, and for the mathematically anxious, mathematically avoidant and generally mathematically unsuccessful pre-service teachers who are usually deemed to be in need of increasing their mathematical literacy skills. This paper is a preliminary report of some of the emotional, language, numeracy and learning management struggles experienced by pre-service teachers in the initial one semester Mathematics Literacy for Educators module in the Durban School of Education at the University of Natal.

INTRODUCTION

There is something funny between me and Maths. It’s like a person trying to catch soap bubbles. Since Grade 1 up to Grade 10 I have been trying to catch Maths … but it is running away from me like a cat and a rat (Sindisiwe: maths autobiography).

The South African national policy document that sets out the norms and standards for educators lists seven competences for educators. One of these is to be a scholar, researcher and lifelong learner. Included in this requirement is the practical competence of “being numerically, technologically and media literate” (Department of Education 2000). This single phrase has implications for teacher education curriculum developers at universities, the mathematics education staff at these institutions, and most of all for the mathematically anxious, mathematically avoidant and generally mathematically unsuccessful preservice teachers who are usually deemed to be in need of increasing their mathematical literacy skills. This paper reports some of the struggles won and lost, and progress made by preservice teachers in developing mathematics literacy in the initial one semester Mathematics Literacy for Educators (MLE) module in the Durban School of Education at the University of Natal.

BACKGROUND AND CONTEXT

The field of traditional literacy, that is, reading and writing, has been expanded to include ideas of “multiliteracies” and “situated literacies” and the social context of literacy is highlighted in the literature (Barton, Hamilton and Ivanic 2000; Cope and Kalantzis 2000). Similarly, internationally attention is being focussed on “real world” contextualised mathematics as opposed to the more abstract formal mathematical structures and rigor of professional mathematicians. This notion of “useful” mathematics is not new and has been advocated, under various names, such as numeracy, mathematical literacy and quantitative literacy in many reports and studies over the past twenty years.

Advocacy of mathematical literacy is based firstly on the obvious practical value of being able to deal with quantitative situations in personal and work situations. Speaking of statistical literacy, Schield (2002) notes that “anybody lacking this type of literacy is functionally illiterate as a productive worker, an informed consumer or a responsible citizen” (p. 41). This suggests a second motivation for a mathematical literacy programme, i.e. to develop the quantitative literacy required for responsible citizenship in a democracy. Steen (2000) considers this contribution of mathematical literacy to be its most profound value to society since “virtually every major public issue – from health care to social security, from international
economics to welfare reform - depends on data, projections, inferences, and the kind of systemic thinking that is at the heart of quantitative literacy” (p. 35). In the light of this, few would dispute that all teachers need to be mathematically literate. The Faculty of Education at the University of Natal decided that a pass in Grade 12 mathematics would fulfil the statutory requirement of numerical literacy, and any preservice teacher (intending to teach subjects other than mathematics at the secondary level) without such a pass would be required to a foundational module in Mathematics Literacy.

The formally expressed purpose of this foundational module in Mathematics Literacy “is to develop mathematics literacy skills in these students [who have not passed Mathematics at NQF Level 4] and to engender self-confidence in their ability to deal with quantitative situations that may arise in daily life or more specifically in their professional lives as teachers (University of Natal 2003). This is very much in line with the definition of numeracy provided by Gal (1995):

The term numeracy describes the aggregate of skills, knowledge, beliefs, dispositions, and habits of mind as well as the general communicative and problem solving skills that people need in order to effectively handle real-world situations or interpretative tasks with embedded mathematical or quantifiable elements.

In 1994, workers in the field of adult mathematical literacy called for the development of an honest list of the skills and knowledge that adults really need to be mathematically literate. The subsequent study involved listening to learners, teachers, employers and other stakeholders in a systematic, structured manner resulting in the identification of four content themes; number and number sense; data; geometry, spatial sense and measurement; and algebra, patterns and functions. These were coupled with the process themes of relevance, problem solving and reasoning, and communication (Curry et al. 1996, p.5). The MLE module was organised around very similar themes and content areas. Most of the examples in this paper are drawn from the data section of the module.

The title of this paper contains the imagery, taken from the maths autobiography of a preservice teacher, of a person trying to catch soap bubbles as a metaphor for learning mathematics. This can be extended to consider the soap bubbles to be the content areas and process aspects of the MLE module. These were the “bubbles” that constituted the module, and were the “bubbles” of mathematical competence the lecturers were blowing. But what were the preservice teachers trying to catch? I suspect they were seeking only the elusive Pass bubble!

Disappointingly, the Pass bubble eluded many preservice teachers and only 40 out the original cohort of 72 achieved the competence required to pass. This was not unexpected as it had become evident, after a few weeks of the module that achieving competence was going to be a struggle for many students. The struggles, from my preliminary analysis of the data, seem to be clustered around the following:

- Struggles to overcome mathematics anxiety and to believe that success in mathematics is a personal possibility.
- Struggles to understand the language used for instruction.
- Struggles to overcome a poor background in basic arithmetic
- Struggles to manage own learning.

**METHODOLOGY AND DATA COLLECTION**

Information on the attitudes that students bought with them to the module was obtained from their mathematics autobiographies, written reflections during the module and interviews after the completion of the module. As the module unfolded, the prior knowledge of the students became evident in their written work. Copies of their work were kept for analysis of error patterns, and conceptual gaps. In addition, useful data was obtained by asking the students to write answers to some questions just before a test on data was returned. They were asked about the extent of their preparation for the test, what they perceived to be their strengths and weaknesses in the section, and to record their response to the results and finally to suggest what both they themselves, and the lecturer could do to improve the situation.
At the conclusion of the module, all students filled in an extensive module evaluation form, and about twenty students volunteered to be interviewed about their experiences in the MLE module. The Postgraduate Certificate in Education students who assisted as tutors in the module, participated in a focus group interview to obtain their insight into the progress and struggles of the students in the MLE module.

SOME PRELIMINARY RESULTS AND DISCUSSION
While recognizing that each student's story and lived experience of mathematics is unique and personal, it is also became clear that these experiences have many common themes. One such theme is the struggle for mathematical competence and the associated struggles with negative emotions, language, poor basic numeracy skills and self management of learning. The complete data set has not been rigorously analysed as yet and so the quotations and examples must be considered as illustrative of emerging themes and as points of departure for further investigation.

Struggles to overcome mathematics anxiety and to believe that success in mathematics is a personal possibility.
The initial sessions in the MLE module were devoted to a small group activity based on a Mathematics Anxiety Bill of Rights (Tobias 1978, p. 237). The groups had to place in rank order what they considered the eight most pertinent rights from a list of thirteen. The clear frontrunner in the collective class rank order was: *I have the right to learn at my own pace and not feel put down or stupid if I'm slower than someone else*, closely followed by *I have the right to need extra help*. This provided the first indication of a mathematically anxious cohort of students, seemingly used to lagging behind the group.

Some students seem to have started out apprehensively and in the full expectation of failure. The despondence is evident in the comment “I am not disappointed, that is what I have been waiting for by looking at my record of mathematics,” written by Victor who had just received a mark of 28% for the data handling test, and the apprehension expressed below by Sizwe.

I internalised that I don’t like mathematics. I know that it is necessary to have mathematics but aish I think it is difficult. To be honest, I think the problem is the word mathematics. That’s the problem. Since I heard that I am going to do mathematics I started not to be relaxed because I knew that mathematics is very hard for me. (Sizwe: interview)

Did the feelings toward mathematics improve in the course of the module? The students were as ked in the module evaluation if they would have done this Mathematics Literacy module if they had had the choice and most replied negatively. For example, Themba indicated that “if I have the choice I would not do this course because I found it very difficult and discouraging and it diminished my hopes of acquiring a BEd degree,” (module evaluation), and Zanele concluded “I don’t like maths and I won’t like it ever”(module evaluation).

On a more encouraging note, some of the students blossomed during the module and really increased in confidence as they experienced some success. This is exemplified by a top achieving student who wrote “I have begun to enjoy maths (just a little) and feel confident to approach maths problems (Rory; module evaluation).

Struggles to understand the language used for instruction.
The issue of language in this context relates to the skills of reading, writing and interpreting spoken English which in most cases was the second language of the students in the MLE module. The lectures were delivered in English with an accent which probably took a while to grow accustomed to. For example, when asked in an interview if he could understand the language in the lectures, Amos replied in the affirmative, and then paused and continued “but not as from the word go. I started understanding at the end of the semester” (personal interview).
In addition to the demands of language in general use in the lectures, this data handling section required students to extract relevant information from tables or text, analyse and interpret data and discuss their findings, all of which required fairly substantial language competence. Rangecroft (2002) speaks of the complexity of dealing with words which have different meanings in Ordinary English, Mathematical English and Statistical English. For example, the word range in Ordinary English could refer to a lot of mountains, in Mathematical English the range is a set of values that the y values in a function may assume, and in Statistical English the range is the difference between highest and lowest scores and so is a single number. Confusion seems almost inevitable especially for second language speakers as the following extract indicates:

Because, Mrs H, English is not our language. …Some of the terms I couldn’t understand it. And some of the things written in English, like in the handouts… I am used to trying to write it in my language and understand it here and there and see that this is what is being asked here and what this section is talking about (Siphama ndla; personal interview).

To add to the confusion, there are quaint terms in basic statistics that describe the shape of the graphical representation of data. For example, we have a box and whisker plot and a stem and leaf plot. Students were overheard speaking of box and whisper plots and one can only wonder what sense they made of the whispers referred to in lectures! Figure 1 shows how the Ordinary English interpretation of stem and leaves caused confusion for a student asked to create a statistical stem and leaf plot.

Struggles to overcome a poor background in basic numeracy
The MLE module is offered at NQF Level 4 and is premised on the assumption that the students have mathematical proficiency to Grade 9 level. In terms of the data handling section, this would imply, for example, that the fraction knowledge to draw pie graphs and the graphing skills of correctly drawing axes would be in place. This assumption did not hold true for students who had not done mathematics for many years, and had not been able to master the subject when they had studied it at school. The student tutors I employed soon realised this.

I had to start everything from scratch to explain what percentages were …how you convert a fraction to a percentage. It was very easy but they didn’t know how to do it they didn’t know what half was (PGCE tutor; focus group discussion).

The regular and ordered sequencing of numbers on a scale is a basic numerical skill that many students lacked. This became apparent when it was noticed that many students were plotting scatter graphs and getting perfect correlations each time. Figure 2 illustrates the incorrect technique of simply writing the numbers equidistantly on the scale in the order they occur in the data supplied. The confusion was confirmed by Sizwe who explained that “I don’t know how to put an appropriate number in the relevant square. I don’t how to calculate it or know this belongs to here or there” (personal interview). Amos attributed his lack of skills (he had just scored 0% for a data test) to his poor schooling background:
My difficulties are that I don't understand the methods of maths. I do not know how to collect that data and where to find them. About the methods I did not know where to start with my work. I am not able to reach the marks needed because I did not ever done maths (written reflection).

Figure 2. Incorrectly labeled axes (data handling test).

I consider the inability to do basic arithmetic as very problematic and a barrier for some students. They appear to understand the new concepts being taught and are keen and excited to try the graphs for example, but basic numerical errors spoil their efforts.

Struggles to manage own learning
The MLE module is scheduled for the first semester of the first year of the Bachelor of Education degree, and so occurs in the context of efforts to get used to university studies which have different demands to school studies. Three such demands which impacted on success in the MLE module were allocating sufficient time to prepare the work in all modules, managing the time allocated in tests, and understanding the university's non-negotiable requirements.

Firstly, the lack of acceptance of the need for, or a personal ability to develop a habit of diligent and sustained application to studies became apparent as many students underestimated the amount of time and effort required to succeed at tertiary institution. Many of the students in this module were fairly mature students who had been out of the education system for several years, and so were unused to the demands of academic work. The more successful students dismissed those who didn’t succeed with comments such as “they are lazy” or “they are not serious, they sleep on their beds while we came to the tutorials” (Boni and Promise; personal interview). Some students did attend the tutorials, but this seemed to form the bulk of their study time. For example, when asked about the time spent preparing for a particular test, Sipho simply wrote “I attended tutorials every Thursday” and Kwanda admitted “I spent more time on the tutorials where I have been helped but not much time by myself” (written reflections). The MLE module was one of five modules each student was doing and students seemed to find difficulty in planning ahead to cope with several tasks due around the same time. This was confirmed by Nozipho who wrote “things were difficult for me because the following day I was writing two tests and I was supposed to submit two assignments” (written reflection).

Secondly, several students spoke of the time pressure they experienced, both within the module and in test situations. This was expressed by Siphamandla in a personal interview.

I am that kind of a person Mrs H, I don’t understand things very easily like other people. I take time to understand things so I need that attention until I understand that thing

Within a one semester module, there was little time to stop, reflect and consolidate. Doing the mathematics under time constraints, as in a test, caused problems for some students such as Lindiwe who
complained that “the time is also very short so we don’t have time to think” and Thabisile who observed that “whenever a person is rushing for something she might do things she didn’t mean to do or even write the wrong things” (written reflections)

Thirdly, I observed a worrying lack of understanding of the notion of achieving certain criteria to pass and a naïve belief that the lecturer can make a failing mark into a pass on a sympathy motive. Several students suggested that a helpful strategy for me to employ would to be make the questions in the tests easier! This misunderstanding is evident in the following extract from a letter written to me after the completion of the module:

I attended all the lectures, doing all the tasks given to me, putting much effort into my work, but it did not help. I do not know how I would answer the question if the first year students would ask me “what should we do to pass Maths?” You are very strict in the above -mentioned matters but we don’t have any benefits, like if you kept all these things and you got 46% in the exam, you should add 4% because this thing is new to us (Sipho: personal communication).

CONCLUDING REMARKS
The 55% pass rate in the initial MLE module indicates that for nearly half the students the metaphor of trying to catch an elusive soap bubble was apt. Among the stumbling blocks, four particular struggles have been identified and discussed. If the need for teachers to achieve competence in the mathematical literacy skills identified in the module is accepted, then strategies need to be put in place to assist students in their struggle.

Promising avenues to be explored include:

- A programme of advocacy to convince students of the usefulness of the module and promote the will to achieve the numeracy outcomes for their own personal competence.
- Creative ways of addressing the language issues must be found, possibly in conjunction with language specialists.
- There must be a mechanism for filling in the gaps in basic skills for those students needing it, and basic competence should be checked for and not generally assumed. Computer aided instruction could be useful in this regard.
- Many students would benefit from the appointment of a mentor to explain the university systems, the non-negotiable nature of module criteria, and to advise on study methods.

If this support does not succeed then many more will join Sizwe in his lament that this Mathematics Literacy requirement in the Bachelor of Education degree has “wiped off my hope of getting a BEd” (Sizwe; module evaluation).

REFERENCES