In this paper we share our experiences of working with mathematical literacy over the past two years. From these experiences we have developed a spectrum of agendas which we believe provides a useful tool for thinking about the different nature of mathematical literacy lessons which are occurring as a result of current curriculum implementation in Grade 10 and Grade 11. Our presentation will particularly focus on this spectrum and will invite feedback from participants as to the usefulness and resonance of such a spectrum for teachers of mathematical literacy.

INTRODUCTION

Since South Africa’s first democratic elections in 1994, there has been major educational reform. Implementation of a new curriculum for school in the General Education and Training (GET) band began in 1997 and in the Further Education and Training (FET) band began in 2006. This new curriculum encompasses radical shifts for teachers both in terms of the content covered and the nature of teaching and assessment. Within the curriculum mathematics is acknowledged for its important role of supporting learners to become active participators in the new democracy. The crucial role of mathematics in developing actively participating citizens is further acknowledged by the introduction of a compulsory mathematics learning area in the FET band. Thus all learners in the FET band must take either Mathematics or the newly introduced option of Mathematical Literacy.

Previously Graven (2000a; , 2000b) analysed the introduction of Mathematical Literacy, Mathematics and Mathematical Sciences (MLMMS) in Curriculum 2005 for the GET band of schooling from the perspective of four different mathematical orientations. The four orientations identified in MLMMS\(^{19}\) (and in supporting documents such as illustrative learning materials, teacher guides and texts) were:

\(^{19}\) These orientations continue to be present in the Revised National Curriculum Statement even while the prominence of orientations 1&2 obtained in their presence in the specific outcomes shifted to the rationale of the RNCS when the specific outcomes were abandoned as primary organising features of the curriculum. In line with this shift the name Mathematical Literacy, Mathematics and Mathematical Sciences was replaced with just Mathematics.
1. Mathematics for critical democratic citizenship. It empowers learners to critique mathematical applications in various social, political and economic contexts.

2. Mathematics is relevant and practical. It has utilitarian value and can be applied to many aspects of everyday life.

3. Mathematics inducts learners into what it means to be a mathematician, to think mathematically and to view the world through a mathematical lens.

4. Mathematics involves conventions, skills and algorithms that must be learnt. Many will not be used in everyday life but are important for further studies.

Primary arguments in that research were that, while all four orientations were present in the curriculum, the way in which they were encountered and experienced by teachers, through their interaction with texts, assessments, departmentally organized workshops and other curriculum support materials, was contradictory. Teachers were often confused by pendulum swinging between orientations and messages that seemed to convey different orientations as good and others as bad at different points in time. Furthermore, the research highlighted that the demand that teachers should work with each of these orientations and integrate across them was unrealistic without a great deal of teacher support and intervention. Even for those teachers involved in intensive in-service education aimed at supporting teachers in navigating their teaching among these orientations, integration between these orientations was a challenge.

In this paper we look at how these orientations appear in the FET band of the curriculum. In particular we look at the presence and absence of these orientations in the Mathematical Literacy option of the FET curriculum and at how a spectrum of agendas is emerging for teachers working with this curriculum.

The four orientations above are clearly present in the FET curriculum. However the splitting of the FET curriculum into pursuing either Mathematics or Mathematical Literacy involves a clear splitting of the orientations and roles in terms of both presence and emphasis.

The FET curriculum is designed in such a way that Mathematics and Mathematical Literacy are different ‘in kind and purpose’ (Brombacher, 2006) and thus Mathematical Literacy is not subsumed in Mathematics. This, combined with the fact that one cannot take Mathematical Literacy if one takes Mathematics\(^{20}\), means that learners choosing Mathematics, by and large, lose out on learning mathematical ways of being in the world. By this we mean learning to use mathematics to “analyse and interpret their own lived experiences, make connections between these experiences and those of others, and, in the process, extend both consciousness and understanding” (Walsh, 1991, p6).

In Mathematics, as was the case with Mathematics in the previous FET curriculum, a strong mathematical agenda is clear with ‘rigorous logical reasoning’ and ‘theories of

\(^{20}\) This is different to the introduction of Functional Mathematics (similar to Mathematical Literacy) in England where the intention is that it is taken in addition to mathematics.
abstract relations’ (DoE, 2003b, p9) being emphasized. The curriculum is content driven and the context of learning is primarily ‘in the context of mathematics itself’ (DoE, 2003b, p9). While the definition includes ‘logical reasoning about problems in the physical and social world’ (DoE, 2003b, p9) which ‘enables us to understand the world and make use of that understanding in our daily lives’ an analysis of the vast amount of content to be covered indicates that this is largely based on the hope that the mathematics content learnt in its abstract and generalisable form will be transferred by learners to use in their daily lives. This is in contrast to an approach which provides contexts and processes that enable learners to experience mathematics in their daily lives. Contexts are useful insofar as they provide access to, and/or motivation for learning mathematics and thus in the learning area ‘Mathematics’ contexts can be contrived in order to meet this purpose. Thus we argue that Mathematics in the FET focuses mainly on the last two orientations with little inclusion of the first two orientations. Concerns that Mathematics is too abstract, catering primarily to meet the needs of an elite minority proceeding to further mathematically or scientifically oriented studies, are addressed by providing Mathematical Literacy as an alternative.

The literacy agenda of Mathematical Literacy is captured both in the name itself and in the definition:

“Mathematical Literacy provides learners with an awareness and understanding of the role that mathematics plays in the modern world. Mathematical Literacy is a subject driven by life-related applications of mathematics. It enables learners to develop the ability and confidence to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems” (DoE, 2003a, p9).

The post-amble headed ‘context’ following the learning outcomes and assessment standards, furthermore emphasizes a literacy approach:

“The approach that needs to be adopted in developing Mathematical Literacy is to engage with contexts rather than applying Mathematics already learned to the context.” (DoE, 2003a, p42)

This is re-emphasised in the teacher guide published in 2006:

“the challenge for you as the teacher is to use situations or contexts to reveal the underlying mathematics while simultaneously using the mathematics to make sense of the situations or contexts, and in so doing develop in your students the habits or attributes of a mathematically literate person” (DoE, 2006, p4)

The three quotations above provide a range of views on the relationship between mathematical content and contexts. However all three quotations make it clear that
Mathematical Literacy in the FET band, in intention at least\footnote{We say in intention at least since various aspects of the curriculum document have been criticized for having far too much ‘traditional’ mathematics content which detracts from the literacy agenda (AMESA, 2003). The inclusion of Trigonometric ratios and the sine, cosine and area rule in the learning outcomes is a clear example of a distraction from a literacy agenda.}, has the integration of both a literacy and mathematical agenda as its core business. Thus we argue that the integration of orientations 1, 2 and 4 are required in Mathematical Literacy.

We now turn to focus on how teachers’ navigate their teaching along a whole spectrum of pedagogic agendas in order to work with the demands of Mathematical Literacy and the integration of the various orientations identified above.

The spectrum we propose below is based on our work with teachers engaging with mathematical literacy in:

- PGCE, ACE and B Sc Hons Mathematical Literacy courses
- A Marang co-ordinated Mathematical Literacy teacher support group
- Marang workshops and research seminars on the implementation of mathematical literacy

- as well as through our intensive longitudinal research of policy implementation in one inner city Johannesburg school.

An overarching aim that traverses across the spectrum of agendas for the teachers we are working with is to increase confidence in mathematical thinking and reduce mathematical anxiety. This issue relates both to the structure of mathematical literacy in the curriculum (set up as an alternative to mathematics) and the current uncertainty as to what the qualification can lead to or provide access to. In most cases, rather than allowing learners to choose Mathematics or Mathematical Literacy, schools make this choice for learners based on learners’ prior mathematical performance (established through assessments in the GET band). The result of this is that most learners taking Mathematical Literacy have far weaker mathematical histories (and confidence) than those taking mathematics.

The spectrum of agendas we have identified here traverses across the question of the nature and degree of integration of context within pedagogic situations, and cuts across orientations 1, 2 and 4 in different ways. The agendas and the ways in which they interact with Graven’s earlier identification of orientations are presented below.
<table>
<thead>
<tr>
<th>Context driven (by learner needs)</th>
<th>Content &amp; context driven</th>
<th>Mainly content driven</th>
<th>Content driven</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driving agenda:</strong></td>
<td><strong>Driving agenda:</strong></td>
<td><strong>Driving agenda:</strong></td>
<td><strong>Driving agenda:</strong></td>
</tr>
<tr>
<td>To explore contexts that learners need in their lives (current everyday, future work and everyday, and for critical citizenship).</td>
<td>To explore a context so as to deepen math understanding and to learn maths (new or GET) and to deepen understanding of that context.</td>
<td>To learn maths and then to apply it to various contexts.</td>
<td>To give learners a 2\text{nd} chance to learn the maths in GET.</td>
</tr>
</tbody>
</table>

**Pedagogic demands**

Involves finding the contexts learners currently need and will need in the future as well as contexts the country needs learners to be able to engage with (& critically) (e.g. notions of democracy, national budgets and taxation)

Needs increased discussion of contexts and critical engagement with the underlying function of mathematics embedded in it. (E.g. if one changes the formatting formula of tax rates what happens, who benefits more rich or poor). Might require revisiting or learning new maths but only in so far as it will service the understanding of the context

Note: the driver is to find contexts that work to unpack this math-context relationship vs finding contexts that are needed by learners for full participation in society

(orientation 2&4 almost equally balanced with some of 1 depending on the context)

Involves selecting contexts (can be real, contrived, authentic, edited or messy) that enable the above. Also involves discussion about context and possible revision of GET maths or relearning of this maths in new way

Pedagogic demands

Involves selecting contexts that GET maths can be applied to (contrived or more real) and editing these to allow ‘unmessy’ application

(mainly orientation 4 + some of 2)

Pedagogic demands

Involves revision of GET maths without pedagogic change except to slow down the pace.

(orientation 4)
<table>
<thead>
<tr>
<th>Issues arising</th>
<th>Issues arising</th>
<th>Issues arising</th>
<th>Issues arising</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progression of mathematics usually sacrificed while authenticity of context is maintained in order to meet ‘needs’ of learners.</td>
<td>Authenticity of context and progression of math embedded must be balanced. Both authenticity of context and mathematical progression can be experienced as a problem. Summative assessments struggle to align to continuous and summative assessments.</td>
<td>Authenticity of context is often sacrificed so as to meet mathematical goals. Mathematical progression can be developed in the same way as in ‘mathematics’ curriculum. Summative assessments are more familiar and performance is more aligned to continuous assessments.</td>
<td>Contexts are not a concern as they are not particularly present. Mathematical progression can be developed in the same way as in ‘mathematics’ curriculum. Traditional summative assessments are similar to continuous assessments so little discrepancy between performance on these – most likely continued poor performance as in GET.</td>
</tr>
</tbody>
</table>

A spectrum of agendas

Based on our analysis of the definition, purpose and post-amble on context and the teacher guide for mathematical literacy, our sense is that the second agenda is the one that should be predominantly pursued over the FET band. However, this should not imply that there are not inconsistencies that work against this agenda present in the curriculum and various supporting documents. For example, analysis of the learning outcomes and their assessment standards indicates that this vision is not clearly supported in the details of the curriculum document. For example the inclusion of trigonometric ratios and the sine and cosine rule would seem to suggest that mathematical agendas are sometimes pursued at the expense of a literacy agenda. In the early stages in the process of implementation of Mathematical Literacy it is not surprising that mixed messages (Venkat, 2007) and ongoing movement in relation to the above spectrum are likely to arise.
Our table highlights various issues that are experienced by teachers when working with a particular agenda. In particular we point to the issues of authenticity of context, development of mathematical progression and discrepancies of continuous and summative assessments. These issues have been experienced by teachers that we are working with in different ways depending on their primary driving agenda.

In the presentation we will discuss these issues further and share some of our data that has led us to engage with these issues. A final note on our proposed spectrum - the spectrum is based on our current experiences of working with a range of teachers. It is of course likely that as we continue to work with a wider range of teachers and into grades 11 and 12 our spectrum will continue to be revised and refined. Furthermore it is hoped that through presenting this work at the AMESA conference we will receive feedback from participants that will guide us in these revisions.

REFERENCES:
Brombacher, A. (2006). First draft of the report on the SAQA Mathematical Literacy Standards at NQF levels 2, 3 and 4: SAQA.