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Opening up spaces for learning: Learners' perceptions of Mathematical Literacy in Grade 10

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Abstract

In this paper we consider the perceptions of learning of Grade 10 Mathematical Literacy students in an inner-city Johannesburg school. Data collected from a questionnaire given to all Mathematical Literacy learners and interviews with a sample of learners confirmed that highly negative experiences of learning Mathematics had been transformed into highly positive perceptions of learning Mathematical Literacy across 2006 – the first year of the subject's implementation in schools. Our analysis of features that figured within this shift in learners' experiences led to the identification of contrast within the nature of tasks and the nature of interaction that provided openings for enhanced participation, communication, and understanding and sense making. In this paper, we argue that such contrasts appear to be necessary to break with negative prior experiences and further, that 'designing in' contrasts in tasks and interaction may be an important part of the message to give to Mathematical Literacy educators if they are to change the negative prior experiences of mathematics learning of many Mathematical Literacy learners.

Key words: Mathematical literacy, learner perspectives, mathematical tasks

Introduction and background

This paper focuses on the perceptions of Mathematical Literacy learning of Grade 10 Mathematical Literacy learners in an inner city Johannesburg school across 2006. Mathematical Literacy (ML) was introduced as a new learning area in the Further Education and Training (FET) phase in January 2006, and was structured as an alternative option to Mathematics. Since January 2006 all learners entering the FET phase have to take either Mathematics[1] or ML. ML is described as a subject that is related to mathematics but different from mathematics in terms of its nature and its aims , and is defined in the following terms in the ML curriculum statement:

> *"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."*

This definition emphasises notions of ML developing quantitative ways of 'seeing' the world ('awareness and understanding'), and participating in and interpreting its activities. ML is therefore

[1]Throughout this paper, the capitalised Mathematics or ML refer to these as school subjects, whilst the small mathematics / mathematical literacy refer to broader notions of these disciplines.

predicated on the notion of developing the kinds of mathematical thinking needed for solving life-related problems. The advice and activities suggested in the Teacher Guide for Mathematical Literacy (DoE, 2006) support this sense of real-world involvement in the provision of exemplar units drawing from a range of everyday situations – utility bills, baking cookies, dam levels data – amongst these.

Feedback from a range of teachers across a variety of school types in Gauteng suggests that in the vast majority of cases ML is not offered as an open choice to learners (Graven & Venkatakrishnan, 2006). Weak and failing Mathematics learners at the end of the General Education and Training (GET – Grade 9) phase are strongly advised to take ML, whilst those passing mathematics are strongly advised to take mathematics. This was largely the case in our focal school, although a small number of learners with good mathematical performance at the end of Grade 9 had insisted upon taking ML against their educators' advice. ML in this school overall though, as in most schools we are aware of, was being enacted with learners with a significantly weaker profile of prior mathematical attainment than the Mathematics classes in the same Grade – an important point to bear in mind in terms of the background to our data on learners' perceptions.

A further point to note is that the Revised National Curriculum Statement for Mathematics in the GET band (DoE, 2002) does highlight the sense that the purpose of mathematics is to develop mathematical literacy:

> *Being mathematically literate enables persons to contribute to and participate with confidence in society. Access to Mathematics is, therefore, a human right in itself.*

We highlight this to emphasise that whilst experience of ML-focused activities should be an aspect of continuity for FET ML learners, their responses suggested significant disjuncture. This sense of a break with past experiences in Mathematics classrooms is central to the argument we propose in this paper – namely that our evidence suggests that negative prior experiences of learning mathematics can be turned around to positive perceptions, and turned around relatively quickly, but that this requires shifts in classroom activity that break with past formulations. In this paper, we theorise learners' comments about what figured within their enjoyment of ML in contrast to their prior experiences in Mathematics. Key aspects relating to what learners described in terms of contrast related to:

- shifts in the nature of classroom tasks
- shifts in the nature of classroom interaction in ML.

Both these shifts provided openings for learners to **communicate** and **participate** in classroom activity, in addition to **gaining understandings and make sense** of the mathematics being used. Importantly, all of these features appeared to have become strikingly closed to these learners within their prior experiences in Mathematics classrooms.

Rationale for the focus on learners' experiences

The paucity of research in South Africa on learners' perspectives that goes beyond performance and assessment data has been noted in previous research . This paper adds, in particular, to the small body of research in mathematics education examining learners' experiences of learning in the context of reform . Our focus on learners' perceptions of ML classes was empirically driven.

Across 2006, a broad swathe of learners across the three ML classes in the focal school expressed enjoyment, and sometimes relief, at being able to do ML. As noted above, in the majority of instances these positive expressions were couched in terms of contrast with their prior experiences of learning Mathematics. Such positive reports of mathematical working are something of a rarity in the field of mathematics education. Internationally, a large body of evidence points to negative experiences of learning Mathematics, and within these experiences, evidence of low levels of confidence, disaffection and lack of engagement. These patterns of anxiety and even fear have been noted in South Africa too , and contribute to ongoing and widespread concerns about low levels of performance in Mathematics at Senior Certificate level. Additionally, theoretical critiques of the ML curriculum have tended to be pessimistic about the potential of ML to alter this situation in spite of its emancipatory claims . In this context, the strong evidence of the widespread turn-around from our focal school (within the first year of implementation) of negative experiences of mathematics learning to positive perceptions of ML learning seemed to us to merit attention. We became interested specifically in the features of ML learning that learners contrasted with their prior experiences in Mathematics lessons.

Theoretical grounding

This empirically-driven notion of contrast with prior experience led us to couch our reporting of shifts in learners' perceptions on a backcloth of socio-cultural theory. Broadly, socio-cultural theories view all aspects of change – in practices, learning, perceptions, etc – as products of shifts in experience (Vygotsky, 1978). A sense of historicity is built into this frame. Our data from ML learners strongly reflected these notions: positive perceptions of ML were related to experiences of spaces opened up for learning through enhanced opportunities for communication, participation and understanding both inside and outside the school. We related this opening to shifts in the nature of classroom tasks and interaction in ML, with prior experiences of Mathematics learning forming the central point of reference. This frame of using classroom tasks and interaction to compare opportunities for learning in different classrooms has been used by Liljestrand and Runesson in their study analysing differences in the sequence of activities across mathematics lessons in two countries.

We have separated our analytical section under the headings of *shifts in the nature of tasks* and *nature of interaction*, but note here that enhanced openings for communication, participation and understanding stemmed from a combination of both of these aspects. These latter outcomes therefore, are interwoven through the frames of tasks and interaction. Our interest in this kind of theorisation was motivated by the improved sense of possibility for engaging with mathematical thinking that seemed to have been enabled within ML lessons in Grade 10 – a shift in disposition that has been conceptualised as a key strand of mathematical proficiency .

Prior to presenting our data on learners' perceptions and our analysis of this data, we briefly outline some background on the focal school and its ML teaching and detail the data sources that we drew upon.

The focal school and our research framework

The focal school was a co-educational, inner city public school in Johannesburg with just under 1000 learners. In Grade 10, there were three maths classes and three ML classes, the latter comprised of 90 learners. Almost all learners in the school are black; the school contains significant numbers of immigrant children with varying degrees of proficiency in English, the main language of learning and teaching. The teaching body is mixed, with black, coloured and white staff. The three teachers involved in teaching ML in Grade 10 were all qualified mathematics teachers, one with three years' experience, another with ten years (the head of maths), and the third with almost 25 years. Across 2006, the head of maths designed activities around, for example, dam levels, routes and costs of inter-city travel in South Africa, and house plans that were used by all three teachers, though not always in the same way. The tasks were drawn from a range of sources – newspaper articles, utilities bills, and ML textbooks amongst these, and usually involved real situations.

Our research in this school was based on an in-depth longitudinal case-study design in which the first author was a participant observer in each of the ML classes once a week across 2006 (approximately 75 lessons in total). It was within the informal interaction in lessons that evidence of highly positive perceptions was initially encountered. In order to understand these positive responses and to gain insights into the aspects that figured within them, we administered a questionnaire to the Grade 10 ML cohort and conducted interviews with a sample of ML learners.

Data sources

The data drawn upon for this paper came from the questionnaire and interview responses. The questionnaire was distributed to all ML learners present in lessons at the end of September 2006 (nine months into the first year of implementation). Semi-structured paired interviews were conducted with a sample of these learners in October 2006. The questions used within both of these instruments were informed by data from ongoing classroom observations, and included explicit reference to the comparisons with mathematics learning that had recurred so frequently with a view to probing the aspects experienced in terms of contrast.

The questionnaire contained six scaled response items, an open response section, and a section asking for areas of contrast between ML and Mathematics (see Appendix 1). Items 1-4 were intended to check the observation-based data on reports of contrasts in 'ease' (items 1 and 2) between ML in Grade 10 and Mathematics in Grade 9, and notions of ML being more enjoyable than Mathematics (items 3 and 4). Items 5 and 6 were more exploratory in nature, and asked about learners' perceptions of their progress and test performance in ML. The open questions asked for general comments on perceptions of ML learning and contrasts with Mathematics. 66 questionnaire responses were received.

Our selection of learners for the interview sub-sample was based chiefly on performance in the ML June 2006 examination, with high performers selected also on the basis of good passes in Grade 9 Mathematics, and hence, having *elected* for ML rather than being told to take it. Two high performing learners, two upper quartile and two lower quartile performing learners were selected from each of the three classes and interviewed in these pairs (9 interviews in all – 8 were paired interviews, one was with 3 learners; 19 learners in total). We conducted the interviews and transcribed them for subsequent analysis. Interviews were transcribed verbatim. In the excerpts we use to illustrate our arguments in this paper, our questions/comments are indicated with our initials (HV/MG); learners' comments are represented by a single initial to protect anonymity. A combination of qualitative and quantitative methods was used to analyse interview and questionnaire responses.

Findings

The strong sense of enjoyment associated with ML that we had picked up in classroom observations was confirmed in the open section of the questionnaire. Versions of the word 'enjoy' – 'enjoying', 'enjoyable' and near-synonyms such as 'fun', 'wonderful' and 'cool', as well as 'interesting' and comments relating to 'liking' or 'loving' ML, figured more frequently than comments relating to any other feature (at least one of these words was used on 55/66 {83%} open responses). The contrast with prior experiences in Mathematics was also confirmed with 57/66 (86%) learners reporting that they enjoyed ML 'mostly' or 'all the time' in comparison with 19/66 (29%) reporting these levels of enjoyment in Grade 9 Mathematics. Detail on the fabric of this contrast in enjoyment was obtained within the interviews and in the open sections of the questionnaire. Aspects figuring within this greater enjoyment were related to ML being 'easier', more visible through being about 'things that we can see', more related to real-life, more understandable for a range of reasons, and, as in the quote below, more interesting:

MG: *So what are your experiences of Maths Literacy so far?*

T: *It's very, very interesting. I actually enjoy it; really I do.*

B: *You won't normally enjoy Maths but Maths Literacy is nicer.*

MG: *So if you compare it to the Maths you were doing last year, you were enjoying this more?*

B: *Ja.*

T: *Ja, basically. It's really much more interesting, ja.*

MG: *So what is it that you think is making it more interesting? What are the types of activities you're doing? What are the kinds of topics that you're covering? You've mentioned statistics.*

T: *Ja, we mentioned – you know, we deal with basic stuff. It's probably more interesting because you look at things in a perspective of scenarios and how you deal with it in real life; unlike in maths where you do trigonometry and you don't know where you're going to meet something like that.*

A sense of the potential for personal action in relation to ML activities comes through at the end of this excerpt in the learner's connection of classroom activities to '*how you deal with it in real life*', a connection that appeared to be absent within experiences of mathematical tasks.

The notion of contrast within the 'easiness' of ML in comparison to Mathematics was also confirmed within the scaled questionnaire items. The variation was most stark at the 'hard/very hard' extreme of the scale with 33/66 (50%) learners reporting that they had experienced Grade 9 Mathematics in these ways in comparison to 2/66 (3%) learners who described ML as hard. However, both the open section of questionnaires and interview data pointed to mixed perceptions about how 'easy' ML was as a subject. Whilst it was certainly viewed as more accessible than Mathematics, there were indications that the sense of 'ease' was, partially at least, an externally given judgement on the nature of ML. 'Ease' was mentioned in all 9 interviews conducted; in six of these interviews, learners talked about being comfortable with the thought of taking ML at the end of Grade 9 because they had been told that it would be easier:

HV:	*Now why did you expect it to be easy – was it because of what everyone was saying?*
M:	*It was because of the teacher last year. He told me that Maths Literacy, it's easier. If you can't see and you're not good in Maths, then take Maths Literacy. He didn't really say 'It's easy' you know.*

However, classroom experiences in ML lessons were beginning to introduce some changes in judgement about how 'easy' ML actually was, as the learner quoted above noted:

M:	*I think Maths Literacy is just like Maths. You know, there are things that I do in Maths Literacy which a Maths student wouldn't be able to cover.*
HV:	*Okay. Alright, that is interesting as well, because I have heard similar kinds of statements from other people on that. So you think, level wise, it is actually quite similar to Maths?*
M:	*Ja, I think it is similar to Maths, because for instance, I have a friend who is really good at Maths and I gave her a Maths Literacy question, and she was like 'Ooh'. She couldn't really understand the question, whereas I expected her to help me and to know it like that. But she couldn't.*

Several comments in both data sources referred to the nature of ML tasks in contrast to the kinds of tasks they had worked on in Mathematics. Learners' responses suggested that ML tasks were connected to 'real-life'. Variants on this theme pointed to a subject that was described as more 'practical', about more 'talked about' things, more applicable, and somehow more 'visible' than Mathematics had been:

> *'Yes, so like – okay, what I can say that – you see mostly interest – ja, I like Maths Literacy and all that because you know, it's talk about like things that I will see everyday; things we use, percentages all that; time and speed. It's talking about something that we know. We know – we usually see and it's much easier to understand.'*

Related to the notion of applicability to real-life, many learners' commented on ML as being more 'useful' than Mathematics, with 'usefulness' linked to everyday situations, future needs and in particular, careers linked to business and accounting. Connected to this idea of relevance to real-life, several learners talked about potentially using the concepts and skills learnt, and some talked about ML learning in terms of active current use outside lessons in ways they had not been able to do previously:

S:	*Even like, percentages right. You go to shops like Edgars and you see here they have written 20% whatever, you wouldn't understand but now it's much easier, okay, the price is this much when they're saying 20% off. You could calculate that and you know what actually - what money am I going to pay and all this.*
MG:	*So you're actually managing to do that now hey?*
S:	*Yes.*
MG:	*And last year, you maybe weren't doing it?*
S:	*No, not really because in like maths literacy they like to go to more details and like to understand better, you know. It's much nicer.*

M: *And business contracts. Let's say cell phone contracts and let's say taking a loan from a bank, like R10 000, all of sudden you're going to pay R20 000. You didn't know where the other R10 000 was coming from. So now whenever like a friend or my mum, she's speaking of getting a phone on contract. She looks at the paper. I always, even if I'm reading the newspaper and then I see this phone you pay R75 for 24 months. Actually take my calculator and calculate how much —*

MG: *So you're actively looking out?*

M: *Looking out for my mum and say "ah, you'll end up paying R20 000. Just think how many phones you could afford, me and my sister and yours".*

S: *And like determining like which one is like better to buy - cash or on credit.*

In addition to the openings for sense-making and motivation for mathematical working, discursive and participative opportunities outside of ML lessons that had been lacking in Mathematics appeared to have been opened up in the context of ML through the incorporation of activities situated in real life contexts.

ML was also reported to be comprised by 'scenarios' or 'story sums'; these were contrasted with the 'x's and y's' which clearly haunted many of their mathematical memories. The scenarios were described as being easy to understand, access and to 'see', again contrasting with the lack of access to sense making and understanding that they appeared to have experienced in Mathematics.

Learning in ML was described in terms of improved understanding. Openings for better understanding were associated with having more time to digest and work with a problem situation, and being in a slower paced and less pressured environment. ML teachers were described as being much more likely to wait for understanding before moving on, and as being more patient – both features that were contrasted with prior experiences in Mathematics classrooms.

Differences in the nature of progression between Mathematics and ML also figured within reports of better understanding, with Mathematics seen as difficult because concepts were rapidly built upon each other:

> *'it's the task and what happens is – maybe there is a section you really find easy, okay, you're comfortable with it, and oh - then they go to something like algebra, which – Oh God! And it's confusing because it's got a lot of concepts in it.'*

Several aspects of the experience of mathematical working are alluded to here that were also commented on by other learners – the pace of conceptual progression that allowed for only fleeting senses of understanding, the density of concepts, and the push towards abstraction/generalisation. This contrasted with the longer time frames given within ML to understand a problem situation – one or two weeks were mentioned frequently.

Pedagogical spaces also figured within the contrasts that had helped to build better understanding with group work and discussion-based activities reported as being much more common in ML than in Mathematics, which was viewed as embodying a much more individualistic style of learning. Within the more collaborative learning environments in ML, there appeared to be more room for sharing ideas and discussing a range of alternative solution strategies:

'It's different ma'am, because this year you are allowed the chance to work with a partner or the group and then you share your point of views, your understanding. Maybe one partner might have a different view of doing the sum, the other might have another, and so you combine your ideas and you see, rather than struggling all alone.'

There was an opening of another space, namely that of assessment, where learners commented much more positively on continuous assessment tasks than on summative assessments. The kinds of tasks set for continuous assessment were described in interviews as being different from what had been encountered in Mathematics. Much greater use was noted of tasks involving research and data collection around real-life situations in contrast to Mathematics where completing class-based mathematical activities had predominated. Time to explore, collect data and consult others was positively perceived.

Summative assessment was viewed as somewhat disconnected from classroom experiences. Lack of time to complete questions was mentioned frequently in the interviews, and contrasted with the unhurried pace that learners described in their ML lessons. Most learners noted that their June examination results in ML were better than prior performance in Mathematics examinations – contributing to their sense of being more confident in their progress. However, these performances were still lower than those in continuous assessments.

Learners also raised concerns about their future prospects with ML, in particular whether ML could 'buy' access to finance-related courses at University level. Uncertainties around whether ML would be accepted were particularly acute for students who commented that they had either chosen, or liked, ML because of the widespread occurrence of finance-related topics:

K: *I'll advise those ones [… 'c9] doing the commerce side of their - commerce, like accounting – ja, like doing businesswoman, businessman – ja, I'd say can take Literacy.*

[…]

MG: *And so you're thinking like business and economics and accounting you said, Maths Literacy would be better.*

Z: *Yes.*

MG: *Because of the financial —*

K: *Ja.*

MG: *You said that earlier.*

K: *You need – ja, Maths Literacy deals more with the financial side*

Analysis

In attempting to ground our analysis in the data, two key aspects of change in classroom experience were prominent in learners' perceptions – the nature of classroom tasks and the nature of classroom interaction in ML in contrast to their prior experiences in Mathematics. In order to encompass the comments made by learners on uncertainties about future prospects related to the structuring and articulation of ML, we added in a further category – ML design features and organisation. Comments in this category were often negative and related to what was perceived as the lack of openings – to tertiary level courses in particular – with ML instead of Mathematics. This sense of foreclosure stood largely in tension with the positive tones that emanated from the two classroom-based analytical headings.

Classroom tasks

The common use of tasks focused on exploring and understanding specific real life contexts formed a central aspect of learners' experiences of ML in this school. Thus, the advice given in the ML curriculum specification to 'engage with contexts' (DoE, 2003, p42) appeared to have been translated into practice. We noted in the last section that learners viewed such tasks as more accessible, practical, 'visualise-able', and as providing openings for communication, participation and sense-making inside and outside school – all aspects that were described in terms of contrast with prior experiences in Mathematics.

The idea that mathematical learning can, and should be supported through linking its teaching with real-life contexts has been advocated both in national/ international research in mathematics education and within previous South African mathematics reform policies (Curriculum 2005 and its revision). The latter feature suggests, as we noted earlier, that integration of mathematics with real-life ought therefore to be an aspect of continuity for ML learners in the FET phase. Learners though were clear that the 'scenarios' encountered in Grade 10 were different from those encountered in GET phase Mathematics. It is important to note here that the nature of the 'scenarios' mentioned by learners – encompassing bank loans, water tariffs, newspaper reports about dam levels amongst these – are very different from the traditional 'word problems' – simply 'dressed up' pure mathematics problems that commonly feature in school mathematics . This difference would appear to be critical to understanding learners' positive responses to ML tasks in comparison to the poor performance and negative perceptions which have been documented with word problems in Mathematics .

Learners' comments that the concrete nature of tasks supported their ability to 'see' what was being discussed is supported in previous empirical research and in allied theorisations that view modelling situations as key to the development of mathematical thinking in addition to providing a motivation for the use of mathematical procedures . This notion of 'seeing' in ML was described in terms of contrast with previous experiences in Mathematics lessons in which the problems themselves – (abstract algebraic examples were most frequently mentioned) - were hard to visualise, and the selection of procedures often described in terms of random guessing rather than any notion of sense-making – a feature that has been noted as common within mathematics education research.

Shifts in learners' reference to the 'ease' of ML were related to this sense of accessibility to making sense of situations. Thus, whilst initial judgements of ML as 'easy' were equated to external (and sometimes personal) views of the subject as 'simple', over the course of the year the notion of ML as 'easy' was used in the more qualified sense of improved access to understanding and problem-solving.

The notion of understanding and analysing real-life situations also appeared to have removed the rapid progression of concepts that was reported as characteristic of mathematical learning, with progression replaced by a sense of needing to understand a situation in depth and borrowing from a range of mathematical content areas to do this – an idea emphasised in the ML Teacher Guide document , and reflected in learner comments about ML tasks encouraging the viewing of "*topics from a scenario type of way*". Learners viewed this focus on scenario-based activities positively, and for some – as the quotes in the last section point out – development had been achieved in terms of both their capacity and willingness to draw on mathematical thinking and working in order to make real-world decisions. Thus whilst we noted that Kilpatrick et al's (2001) 'productive disposition' was the key area of shift for these learners, there were instances of broader development across other strands of proficiency too.

As this cohort of learners approach their Senior Certificate examination though, learners' weaker performance in examinations relative to continuous assessment performance becomes more problematic. Uncertainties about the nature of progression and assessment within ML have been noted in previous writing . Lack of detail on progression is particularly apparent in the Assessment Standards for ML. The ML curriculum statement acknowledges a lack of detail on progression in the Assessment Standards (DoE, 2003, p38) and suggests that progression ought to be achieved thus:

> *'The complexity of the situation to be addressed in context, through using the mathematical knowledge and ways of thought available to the learner, is where the extent of the progression needs to be ensured.' (ibid)*

This kind of increasing 'complexity of the situation' was not clearly evident in the range of tasks used across 2006, and increasing complexity was not mentioned by learners. What learners had gained through the tasks and the longer timeframes given to work was an experience of sense-making within the scenarios encountered. Learners were encouraged to become mathematically literate within scenarios and our data pointed to some successes here. However we lack hard evidence currently of their becoming more mathematically literate in a general sense in spite of their clear enthusiasm.

Learners' sense of an improved understanding of the kinds of tasks they were given was supported by more frequent opportunities for interaction – both within and subsequently beyond the classroom. The aspects and nature of classroom interaction are now analysed.

Classroom interaction

Learners' frequent comments that they were given more time to understand situations in ML and that teachers waited for them to understand pointed to a slower pedagogic pace in ML classrooms than that which had characterised mathematical learning. The fast paced working that is a common feature of school mathematics has been documented in international research , with South African research indicating teachers' struggles to meet the conflicting demands of curricular specifications that outpace learners' understandings by several Grades . Teachers in the focal school and more broadly commented that the less dense nature of the ML curriculum and the lack of detail on progression and the Senior Certificate ML examination were factors that made them willing to 'wait' in ML in contrast to the imperatives to rush ahead in Mathematics. What appears to be emerging in ML in this school, therefore, is a more genuine sense of working with 'learner-centredness' – a key tenet of post-apartheid curriculum reform. Whilst such underpinning has been called for within all learning areas (subjects), previous research has pointed to either its restriction to the level of rhetoric , or limited evidence of teaching that can be called learner-centred . Thus, ML appears to be opening up pedagogical spaces for educators which in turn contribute to the spaces opening up for learning.

Learners also commented on the more extensive use of pair and group work in ML in comparison to Mathematics where individualism and competition predominated. Both these latter features have been documented as common features of traditional patterns of work in mathematics classrooms . As noted earlier, group work was advocated in Curriculum 2005 and has been documented in practice following implementation . However, learners in our focal school were emphatic that the use of these forms in ML contrasted with prior experiences in Mathematics classrooms. One aspect of the use of these forms in ML within our data was the emergence of a more co-authored style of working with learners commenting on having the space to author opinions and come up with alternative problem-solving methods.

We noted in the last section that the real-life, 'public' nature of tasks opened up opportunities for learners to discuss their ML classwork within lessons and beyond. For some learners, access to knowledge in relation to these public issues such as budgeting and banking had produced powerful positional shifts in their participation in family life and active development of mathematically literate behaviour was apparent in their reports.

More broadly, we noted in our data an absence of comments from learners about difficulties in accessing questions or contexts in spite of the often extensive use of English text, which we expected to be a problem for our sample of learners for whom English was a second or third language. This absence was in sharp contrast to widespread concerns expressed by educators and researchers in mathematics education about lack of English language proficiency preventing learners from accessing contextualised problems , and consequent equity-based concerns about the use of contextualised problems in mathematics . Our surmise here is that the extensive use of communication and discussion in class of scenarios that begin at least, with a less technical register than that used in traditional mathematics tasks and supported further by openings to discuss tasks during and outside lessons, has scaffolded learners' access to problem situations in ways that the more limited nature of interaction in Mathematics was unable to do.

Design features and organisation

The structuring of the Mathematics/ML choice is often interpreted as a replacement of the previous Higher Grade (HG)/ Standard Grade (SG) distinction that used to exist in Mathematics. This is despite strong statements from those involved in development of the ML curriculum that ML is not equivalent to Standard Grade mathematics (Brombacher, 2006; Laridon, 2004), and historical pressures for the development of alternative kinds of mathematically-oriented courses focused on life-related use (Venkatakrishnan & Graven, 2006). This (mis)interpretation appears to be prevalent within current uncertainties over whether ML will be accepted in the Higher Education sector for access to degree courses in finance-related disciplines, with differences beginning to emerge between institutions on this question. Consequences of this uncertainty were apparent in both the implementation of ML in our focal (and other) schools with a lack of open choice between mathematics/ML for learners and in learners' concerns about the 'trade-value' of ML in relation to higher level study and career choices. This situation is particularly problematic for the small numbers (in this school) who chose ML due to their interest in finance-related mathematics, despite having done well in GET Mathematics and being encouraged to take Mathematics in the FET band. This group of relatively able learners are continuing to achieve highly in ML and strongly aspire to go onto degree level courses in Economics/Commerce or related areas. It is worth noting that many within this group of learners are exhibiting the kinds of flexible, applied problem-solving capabilities that have often been seen as lacking in students coming through with appropriate qualifications in school mathematics .

A further point to note in consequence of the structuring of ML as an alternative to Mathematics in a climate of uncertainty is that the previous options available to FET learners: HG Mathematics / SG Mathematics / No mathematics - have translated largely into the situation depicted below:

HG + strong SG learners	Weak SG + no mathematics learners
Mathematics	Mathematical Literacy

The consequence of this situation for ML educators is that they are likely to be implementing the new subject with a cross-section of learners that they have little experience of dealing with in the FET band. As the learners in this study attested to, many of them came into ML with weak prior attainment in Mathematics, and low levels of interest and confidence in their ability to engage with mathematical thinking. Changes in classroom experience were therefore critical to fostering engagement and establishing ML as a valuable addition to the FET curriculum.

Conclusions

We re-emphasise here that shifts to positive perceptions have depended heavily on contrasts in experience from Mathematics in the GET years. Within the shifts noted in the nature of tasks used and in the patterns of classroom interaction there is evidence of change, from the perspectives of learners, to ML classroom environments that better support their participation and engagement. More learner-centred pace of working and tasks focused on engagement with scenarios that open up discursive opportunities both figure within this change.

A minority of learners talked about active current use of mathematical judgement in a range of situations. This could be argued to provide some evidence of 'transfer' – the flexible application of learning from one context to another - a goal that has proved elusive within mathematics education. The examples that learners told us about though indicated very direct connections currently between in-school learning and out-of-school use. For example, working on the structure of real cellphone contracts in class allowed some learners to do similar calculations in real-life, and similarly, discounts offered in sales – an issue covered in class – was also actively used during shopping. These examples, whilst evidencing active recognition and use of in-school learning, do fall short of the kinds of flexible problem-recognition and problem-solving that Boaler (1997a) suggested could emanate from shifts in the nature of tasks and interaction that often constitute mathematical learning.

In spite of these concerns, a space for learning does appear to have been opened up in the arena of Mathematical Literacy, with learners who had shut the door (or had the door shut for them) with respect to Mathematics. One learner in our interview sample commented on ML as '*like being in crèche, you learn how to play with a new toy*'. This view reflected the sense of exploration, of working without fear of failure or ridicule, and of learning with enjoyment that underlay our reading of the data in terms of opening spaces for learning.

These findings emanate from one cohort of learners in one school. We are aware that the implementation of ML more broadly has occurred with a range of classroom enactments related to a variety of interpretations or 'pedagogic agendas' (Graven & Venkat, 2007) focused on how ML is perceived by teachers. We cannot make broader claims therefore about the efficacy, usefulness or success of ML in schools. What we do say though is that in our focal school, ML has offered openings for a different kind of engagement with mathematics, and importantly, it has offered these openings to learners who have often entered the FET phase with highly negative prior experiences of learning mathematics. This finding was, in relation to theoretical critiques of the ML curriculum specification, and the disaffection and generally low prior performance of the learners taking the subject, highly unexpected.

Our hypothesis is that this shift has been facilitated at a relatively simplistic level by changes in the nature of tasks and interactions used in ML classrooms. Further investigation in a broad cross-section of schools will be needed to better understand the nuances of task use and interaction in ML, but in terms of initial shifts, this message of where change needs to occur may be an important one to send out to ML educators.

Our findings in this school provide evidence that changing learners' perceptions of mathematical working is possible. Learners' comments alerted us to the need to provide clear contrasts with prior experiences in mathematics in order to successfully broaden access to and engagement with mathematical thinking and problem-solving. The implementation of ML in this school appears to have provided fertile ground for the opening of pedagogical and assessment spaces that foster a re-engagement with learning and mathematical sense-making.

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Appendix 1

Students' Mathematical Literacy Questionnaire, Grade 10 - September 2006

These questions ask you to think about your experiences in mathematical literacy lessons this year. Your responses will remain confidential.

Gender: Male ______________________ Female ______________________

Maths Literacy teacher's name: ______________________________

1. Have you found the work in Maths Literacy this year:

very easy	easy	about right	hard	very hard

2. In Grade 9 Maths lessons, did you find the work:

very easy	easy	about right	hard	very hard

3. Do you enjoy Maths Literacy lessons:

all the time	mostly	sometimes	never

4. In Grade 9, did you enjoy Maths lessons:

all the time	mostly	sometimes	never

5. How happy are you with your progress this year:

very happy	quite happy	unhappy	very unhappy

6. How do you feel about your test marks this year?

very happy	quite happy	unhappy	very unhappy

Please comment here on your experiences of learning Mathematical Literacy so far this year. You can comment about your lessons, the kinds of topics you have covered, the tests, and whether you are enjoying the subject, or other aspects. Your comments will be kept confidential.

What do you see as the main differences between Mathematics and Mathematical Literacy?

Mathematics	Mathematical Literacy