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Chapter 35
Mathematical Literacy in South Africa: Increasing Access and Quality in Learners' Mathematical Participation Both in and Beyond the Classroom

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Introduction

This chapter tells the story of how Mathematical Literacy (ML), as a new subject introduced in South African schools in 2006, opened access to mathematical learning and enabled the mathematical "metamorphosis" of learners in one school. The aim of the chapter is to share the way in which this curriculum intervention has the potential for enabling increased access and quality mathematics education particularly for learners with weak mathematical histories.

The chapter is based on data gathered from two case study classrooms of the first cohort of ML learners in one independent Johannesburg school. The chapter is jointly authored by Esme Buytenhuys, a teacher of one of these classrooms, and Mellony Graven, who at the time of the research[1] was the co-coordinator of the Mathematical Literacy Research and Development thrust of the Marang Centre, Wits University. Esme writes the story of the metamorphosis of the learners in her school based on her experience of working with these learners, reading their journal entries and most importantly reading their "mathematical stories" written on the last day of their 12 years of schooling. Mellony provides the contextual background to the story and some reflective analysis of the story which draws on Sfard and Pru-

[1] Esme and Mellony met at a Mathematical Literacy workshop organized as part of Mellony's work in the Mathematical Literacy Research and Development thrust. At a follow-up ML support group meeting Mellony was drawn to a range of ideas that Esme brought and requested that she and a colleague, Hamsa Venkatakrishnan, visit with her in her classroom to learn about the teaching of the subject. This was the beginning of their relationship which included interviews and visits over the three-year period.

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sak's (2005) narrative definition of identity. Thereafter, we engage with the relationship between the story and the curricula features that supported the more positive evolution of learner mathematical identities.

Our story begins from the point of departure that learners can constantly reauthor their mathematical stories and their lives. It focuses on ways in which learner choices to take ML instead of Mathematics in grades 10–12 freed them from ongoing stories of mathematical failure and enabled increased (and new forms of) mathematical participation, sense making, confidence and enjoyment.

Mathematical Literacy in South Africa

Mathematical Literacy (also commonly referred to as Maths Lit and abbreviated ML) was introduced in schools in the Further Education and Training (FET) post compulsory phase (grades 10–12, learners mainly aged 15–18) in South Africa in January 2006. The subject is structured as an alternative option to Mathematics, and all learners entering the FET phase since January 2006 are required to take one or other of these two options. ML is defined as a subject driven by life-related applications of mathematics that must develop learners' ability and confidence to think numerically and spatially in order to interpret and critically analyze everyday situations and to solve problems (DoE 2003). The rhetoric also foregrounds issues of quality in relation to enabling a learner to become "a self managing person, a contributing worker and a participating citizen in a developing democracy" (p 10). The emphasis in curriculum documents on developing mathematical competence and confidence, and ways of being and acting in the world, highlights the aim of developing positive mathematical learner identities. Evidence from schools suggests that in practice, learners with weak mathematical histories, competence and confidence are mostly guided towards taking this new subject.

The rhetoric of the rationale for ML foregrounds issues of access. The introduction of the subject addresses the concern that in the past approximately 50% of all Grade 10–12 learners did not take Mathematics and there was widespread concern for the high levels of innumeracy and poor performance on international studies. Mathematical participation was furthermore skewed along racial lines (see also Reddy 2006). Thus political will (rather than an initiative led by teachers or educators) led to the introduction of ML with the intention that all learners in the FET band would study mathematics in some form.

Initial design of the curriculum was by a group of department officials appointed by the Department of Education. The names of the members of this group are not publicly known but there was no consultation with the various mathematics education structures that exist in the country. The initial instruction was that it should be an easy mathematics without clear ideas of what this meant (According to A. Brombacher (personal communication, January 2010)). Shortly after the curriculum was designed, a ministerial committee was elected to review both the Mathematics

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and ML curricula and consultant Aarnout Brombacher (an ex Mathematics teacher and ex president of the national Mathematics Teachers Association AMESA) was brought in to head this review. Following this review, Brombacher developed the Subject Assessment guidelines (DoE 2008) and a Teacher Guide (DoE 2006) for ML. It is in these documents that the curriculum rhetoric begins to veer off from the possibility of being interpreted as a watered down mathematics curriculum. "Mathematical literacy is a different kind of mathematics, not a different lower level of mathematics" (Brombacher 2005).

Thus curriculum rhetoric which emphasized ML as a way of being and acting in the world became foregrounded in subsequent documents. The subject definition "driven by life-related applications of mathematics" (DoE 2003, p. 9) was thus taken to mean learning must be anchored in the real world and mathematics and context must be brought together in a dialectical relationship. Thus the Teachers' Guide notes:

> 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, p. 4)

The purpose of ML is stated in terms of what learners are to become and to be and within this rhetoric an underlying socio-cultural framework is evident. For example, "Mathematical Literacy should enable the learner *to become* a self managing person, a contributing worker and a participating citizen in a developing democracy…" (DoE 2003, p. 10) and "to handle with confidence…enable them to deal effectively with mathematically related requirements in disciplines such as the social and life sciences" (DoE 2003, p. 11).

In contrast, while there is some mention of relatedness to the real world in the Mathematics curriculum, this curriculum states "Mathematics is a discipline in its own right and pursues the establishment of knowledge without necessarily requiring applications to real life" (p. 9). The Mathematics curriculum is a more knowledge-driven curriculum with clear disciplinary boundaries and a focus on vertical mathematical progression necessary for further studies. Thus the curriculum states: "If a learner does not perceive Mathematics to be necessary for the career path or study direction chosen, the learner will be required to take Mathematical Literacy" (p. 11). Key differences between two curricula are summarized in Table 35.1:

Table 35.1 Key differences between ML and Mathematics

Anchored in the real world	Anchored in the discipline of Mathematics
Focus of rhetoric: ways of being and acting confidently in the world	Focus of rhetoric: knowing and understanding
Learner histories: weak competence and low participation	Learner histories: some strength, competence and participation within the disciplinary boundaries
Trajectory—into the world (citizenship) and social and life sciences studies	Trajectory—into further mathematically oriented studies

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Thus ML tends to be driven by real life scenarios—and teachers are encouraged to keep these current and relevant to the interests and needs (including future needs) of their learners. For example, investigating electricity consumption and the effects of leaving appliances in standby mode have been suggested by Brombacher as a useful ML scenario. Electricity consumption is currently a "big issue" in South Africa as there is not enough of it, and households and businesses across the country are experiencing power outages and intermittent "load shedding." Other examples of scenarios given in the teacher guide (DoE 2006) include: calculating telephone costs; comparing between cell phone and land line costs depending on the needs of individuals; investigating pyramid schemes, loyalty programs, banking charges, etc. Teachers are encouraged to source data for such activities from current telephone directories, cell phone brochures, newspaper adverts and articles.

Despite such activities one of the greatest issues for learners in choosing to take ML relates to the perceived low status of the subject. Thus while the curriculum document states that ML should be taken "if a learner does not perceive Mathematics to be necessary for the career path or study direction chosen" (DoE 2003, p. 11), the more commonly told story is that it is for those who cannot do mathematics. Such stories (or "stereotypes" as referred to by learners) are problematic and get in the way of the subject achieving its full potential. However, as our story will show, positive learner experiences in relation to this subject allows learners to challenge these stories and create new stories about its value and their mathematical competence.

There are a range of concerns relating to the introduction and implementation of the ML curriculum. These relate to, for example, contradictory messages within curriculum documents (Christiansen 2007), the status of the subject (Sidiropoulos 2008), the validity of its assessment and the value of its currency (Jansen 2009a, b) and teacher shortages (Reddy 2006). These concerns are real and large-scale national research is required in order to reflect on the extent to which ML has met its stated aims and purposes across the country.

Our contribution in this chapter does not aim to address the above issues but rather to highlight, from the case study of one cohort of ML learners in one school (followed from Grade 10 to 12), the *potential* of this subject to transform learners, who defined themselves as mathematical failures and nonparticipators, into mathematical negotiators, participators and sense makers both in and beyond the classroom. In presenting this case the chapter focuses on the way in which ML enabled access to forms of mathematical participation and sense making not previously experienced by these learners in their schooling. The chapter also addresses the issue of "quality" of mathematical learning in ML from the perspective of the learners. In particular, learners' anecdotes of their mathematical learning crossing the boundary of the classroom into their everyday lives challenges the validity of perceptions of the lower quality and status of the subject. While we sometimes use the words of the learners to illuminate our story like Sfard and Prusak (2005: 20) we "urge the reader to remember that what follows is a story about stories."

Before telling Esme's story, we briefly introduce to you Sfard and Prusak's operational definition of identity and its connection to stories.

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Defining Identity

The term "identity" is not fully useful in relation to Esme's story unless it is given a clear operational definition. Sfard and Prusak (2005) point out that while "identity" is a term that is widely used in educational literature it is seldom clearly defined. To provide "identity" with an operational definition Sfard and Prusak (2005, p. 16) define identities as "collections of stories about persons or, more specifically, as those narratives about individuals that are reifying, endorsable, and significant."

Reification comes with verbs such as "have" (e.g., "I have strong mathematical ability") and I would add with declarations of one's being such as "I am" (e.g., "I am mathematically stupid"). Stories are considered endorsable if the identity builder can answer to them being a faithful reflection of a state of affairs (e.g., "I say I'm mathematically stupid because I constantly fail my tests"). While stories are *significant* if a change in the story is likely to affect the storyteller's feelings about the identified person—e.g., a change in the story that "Math Lit learners are mathematical failures" to "Math Lit learners have a preference for learning life-related mathematics" is likely to lead to a change in feeling by the storyteller about learners.

Thus, within their definition identities are human made, collectively shaped by authors and recipients. They explicitly highlight that their definition presents identities as the discursive counterparts of lived experiences whereas others such as Wenger (1998, p. 151) see such words as only a part of "the full, lived experience of engagement in practice". Sfard and Prusak thus stress "No, no mistake here: We did not say that identities were finding their expression in stories—we said they were stories" (p. 14).

We will return to this notion of identity when reflecting on Esme's story.

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Esme's Story of the Mathematical Transformation of Learners in Her School Reading the journals and stories of my learners and reflecting on our three-year journey together made me realize just how enriched I have been by this exercise of committing my findings to paper. Teaching ML is indeed a very rewarding experience and yet at the same time an incredibly difficult one. My learners and I started out not knowing exactly where we were going and how we were going to get there—but with time we trusted and invested in each other and embarked on the journey together.

For me, looking back, I now see this journey as a complete metamorphosis.

The Caterpillar Stage I clearly remember those first few months with my six Grade 10 Maths Lit learners. They started out slinking into my classroom looking for a place to hide—to go unnoticed for 45 minutes. There was a tangible, invisible barrier between the learners and me—created by them. Reflecting on this, in discussion with Mellony, Hamsa and others, helped me to make sense of this. I began to understand the nature of the learner who appears in the Maths Lit class at the outset of Grade 10. These are precious

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young people who have been mathematically abused and for most as early as in Primary School.

In all the student stories about their mathematical experiences there were repeated emotive words and phrases such as: "failure," "struggle," "stress," "nervous," "hated maths," "worry," "extremely difficult," "no confidence," and "hopeless."

For example, learners wrote:

> During high school I hated Mathematics because it never made sense to me.

> From since I can remember I have struggled with Maths. I would always try my best but never see results

Many learners wrote of their feelings of hopelessness and how they eventually gave up.

> It's no fun knowing that there is no hope in the world that you can pass the tests.

> In Grade 8 and 9 I was told to go to extra Maths before school, but by this time I had lost interest and was tired of trying my best and *never* seeing results.

Many learners also connected their negative mathematical experiences to their broader self image. For example one learner wrote: "I used to hate anything and everything that had to do with Maths. My struggle with Maths also negatively impacted my self-confidence, and left me feeling like I was stupid and useless."

These learners were too scared to partake in discussions. Getting an answer or opinion from anyone was like drawing teeth. One of my vivid memories of one girl's perceived hopelessness is when she put up her hand to answer a question and then quickly put it down again. When I encouraged her she replied "no don't worry, my answer is probably wrong anyway."

The first part of the journey was to get the learners to start changing their perception about themselves. Only by reading their journals I realized just how difficult it must have been for them. Over the three-year period, my class grew from six to fifteen learners. Most of my class stated that they felt like failures because of their mathematical experiences. Not only did they see themselves as failures, they also had the snide comments from the Mathematics learners to deal with. Quite a few of them said that they were embarrassed doing Maths Lit because of the negative opinions and comments of other learners. My initial group, as well as those who changed in drips and drabs, didn't really have a choice in doing Maths Lit in the sense that it was clear that if they continued with Mathematics they would fail.

Interestingly, learners who only joined ML in Grade 11 seemed to show a greater intensity of emotion in relation to their struggles with Mathematics. Many of the girls shared how much crying and stress went into trying to cope with Mathematics. "Maths for me was a daily struggle I got stressed and cried

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a lot because of my inability to grasp the concepts." One of the boys even stated "before Maths Lit my life was a mess.… It's like there was a large gaping hole that I just couldn't fill." The intensity of the emotions in their stories possibly relates to their extended experience of learning mathematics in the FET band.

Another aspect of emotion that the Maths Lit learners had to deal with was the teasing they received in terms of the lower status of the subject as well as their own feelings that they were taking the subject because they were "stupid." In some cases students who changed much later to Maths Lit were the teasers of the initial group of learners who took Maths Lit from the start of Grade 10. For example one learner wrote: "I always mocked the children that decided to drop to Maths Lit, but that's only because I didn't really understand what it was all about."

It took about six months to get my initial group of learners to accept that I was on their side and that as a team we could achieve a new and positive maths experience. I positioned myself as a colearner—as indeed I was. This curriculum and many of the scenarios we explored were new to me as well. I insisted that nothing they said was stupid and all avenues of thinking would be explored. There was space in the curriculum for increased discussion and allowing for diversions in these discussions. I insisted that they should not look to me for answers—I did not have them. The only way to learn was going to be through engagement. At last they began to gain confidence and were willing to risk participation in discussions. My initial group was quite pleased with themselves when they saw that they were achieving better results than their peers who changed to Maths Lit at a later stage during Grade 10. In their own minds they had the poorest mathematical abilities. Then they began to succeed—*for the first time* the amount of effort expended was proportional to the results they achieved. Their successes were noted enviably by the Mathematics learners.

The Pupa Stage This is the stage when the learners begin to savor the good experiences and build on them. Knowing that success can be repeated the fear of failure diminishes. Classroom discipline becomes so much easier because they feel good about themselves and are not hiding behind a behavioral problem to cover up for their inadequacies. The learners tend to become actively involved in the task at hand and they thrive on the manner in which engage with the subject. One learner had this to say about Maths Lit, "unlike Maths where you stress and cry over a sum, Maths Lit allows you to go out and see things in action being made; we are put in situations where we must work together in a fun and new way so that we may discover for ourselves the solutions to everyday problems."

Success leads to a greater desire to be challenged and the learners begin to believe that they are able to tackle anything. Their self-esteem in relation to

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Maths starts changing—they begin to redefine themselves as learners who are willing to give it a try and as learners who can figure it out.

Getting weaker learners to do their Maths homework has always been an uphill struggle for me. I was under the impression that learners who didn't do homework didn't care or were lazy. I realize now how wrong my perception had always been. A few learners "journalled" about homework and one of them helped me gain new insight regarding this matter: "Since I was young I refused to do Maths homework, not because I didn't want to but because I simply did not understand the work that needed to be done."

In addition, learners linked this ability to make sense and "figure it out" to increased independence. A learner explained: "Its (ML) in English…Its easier to catch up because you can go home and you can read it…Whereas Maths, you need someone to actually like intensely explain it." Homework is not much of an issue in the Maths Lit classroom anymore. The learners actually feel proud of being on top of the situation.

The Butterfly Stage This is the stage when I look at the learners and observe them with pure delight. They are beautiful and whole; and ready to spread their wings. What do I observe?

I see individuals reflecting on answers and the calculations. They check that the answers make sense. They reassess and rework the problem until the answer is sensible and realistic. The Maths Lit learners become inter-dependent: they discuss answers that don't make sense; debate issues mathematically in order to establish meaning for themselves then collectively decide on the most appropriate answer. They are able to make sense of numbers—a skill they thought they didn't have prior to Maths Lit. They have reached a stage where they are able to confidently enter into debate with me. There have been times when their methods have been better than mine. These learners have evolved into mathematical negotiators who no longer shy away from "maths." In addition, the learners' positive experiences spilled over into the exam situation (and their marks were gradually improving) as one learner expressed herself: "Maths Lit has boosted my confidence and now I know I can do well in my exams without the stress of not understanding." Others echoed similar sentiments, "I no longer dread the Maths period, I do really well in exams and I'm always excited to write them."

While many learners at the start were concerned that taking Maths Lit would limit their access to further studies, now some realized that by getting a good symbol for Maths Lit (as opposed to a very low symbol for Mathematics) increased their points quota required for accessing universities. One learner draws this conclusion, "My marks have improved greatly. The average on my report, for Maths Lit, has changed my final symbol which has helped me in applying to university." Another learner writes, "I plan to study Business Management next year and Mathematics is not a requirement,

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having heard this, my choice to take Maths Lit was easy as it takes the stress off me."

In the final National Senior Certificate Mathematics exit exam, all of the 34 Grade 12 learners passed and 13 of them passed at the highest level (achieving "Level 7—outstanding," i.e., 80–100%) while 16 achieved at the second highest level "Level 6—meritorious," i.e., 70–80%). The metamorphosis is captured by a learner who shares her experience:

> At first, I have to admit, I felt like an idiot; people see it (Maths Lit) as a really easy and pathetic subject, when in reality it is not. It is actually a very interesting and useful subject that teaches you to apply mathematical concepts in your everyday life. We learn maths that you will actually use one day. My decision to change was one of the best decisions I have ever made and I don't regret it one bit…It has made me a happier person.

Similarly, Greg's story of transformation is one that will always live with me. I journeyed with him during his difficult and sometimes painful experiences during the years he was in my class. He came to me in Grade 8 with a mathematical history that spoke of failure. No amount of extra maths or revision helped improve the matter. He joined me again in Grade 10 even more despondent. In his journal he reflected:

> Maths was the most terrible part of my school career. I always used to dread coming to my Maths classes because I never used to know what I was doing.… I always used to get the worst marks in the class. I didn't want to choose Maths Lit because I thought it would be embarrassing but throughout the years I have realized that choosing Maths Lit was definitely the best thing I have ever done in my school career. I loved going to Maths Lit because I know that I'll be using the maths that we learn in and out of my life.

By the end of Grade 10 he achieved 51%. Greg was beginning to remold his relationship with Mathematics. As time passed, Greg became more confident and self-assured often adding value to the class discussions. He was proud of his achievements and was even able to refute the taunts from "Core" Maths learners. He wrote: "Everyone is going to have to buy a house; and calculate electricity and telephone bills—I know I can. I can calculate how to build a house right to the last brick! Can normal Maths kids do that? How's about nooooooo (no)." While Greg's reference to "normal" Maths is somewhat problematic in how it positions Math Lit, his increasing confidence remains clear. Greg attained 61% in his Matric finals and still basks in this success.

I am extremely privileged to have embarked on this pioneering journey—I too have been transformed. ML most certainly has more than just the *potential* to transform learners: it has healed many dysfunctional young adults. It has set them free and given them wings to fly. I think this is a sentiment that is growing. On a Matric Graffiti Wall at another private school, I noticed a learner had written: "Math Literacy 4 future world leaders."

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Reflecting on the Story

The story highlights the way in which the teaching of ML as a subject in these classrooms, provided learners with the opportunity for developing new identities in relation to mathematics.

Our chosen definition of identity gives increased agency to the learner and the teacher as it opens the space for the reauthoring of learner identities. It is this agency and space for reauthoring that is particularly appealing for reflecting on Esme's story. It highlights the important role that significant narrators, (e.g., teachers such as Esme), can play in deliberately challenging existing negative stories of learners and the importance of reflecting on their own intentional or unintentional authoring of learner identities.

Thus within this definition of identity, as discursive counterparts of one's lived experiences rather than some intangible (and stable) entity, reauthoring of identities is not only possible but we argue is necessary for enabling and giving momentum to learning. We believe this is especially important in cases where identities have been negatively constructed as stories which are stumbling blocks to learning. Thus Esme notes that the first part of the journey was to get the learners to start changing their perception about themselves.

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Freeman and Combs (1996) argue that the metaphor of stories helps one to see how stories circulate in society and how these realities are socially constructed, constituted through language and organized and maintained through narrative:

> When life narratives carry hurtful meanings or seem to offer only unpleasant choices, they can be changed by highlighting different previously un-storied events, thereby constructing new narratives. Or when dominant cultures carry stories that are oppressive, people can resist their dictates and find support in subcultures that are living different stories. (p. 32–33).

The final sentence highlights the opportunity for groups of people in supportive communities or "communities of practice" (Wenger 1998) to enable "living different stories." Supportive communities, such as those formed in the ML classes in this school should open up these alternatives especially when existing stories "carry hurtful meanings," undermine mathematical identities or impede learning. As we see in Esme's story these alternatives were opened up and members of these communities became the new "significant narrators" that told stories of mathematical competence and rejected the stories of other students that they were mathematically stupid. Learners began to argue back to Mathematics students that ML was different mathematics rather than inferior mathematics and began to challenge the appropriateness of its lower status. For example Greg wrote: "I can calculate how to build a house to the last brick! Can normal Maths kids do that? How's about Noooo (no)." Thus, we see that through the development of the ML classroom as a supportive community, learners such as Greg are able to reject the significance of oppressive, negative stories and give more significance to the stories emerging within the community and told by their teachers about their mathematical learning.

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Sfard and Prusak (2005) continue to identify two sub categories of stories: *current*[2] identities (told in the present tense and formulated as actual assertions) and *designated* identities (narratives expected to be the case—now or in the future). Learning is then conceptualized as closing the gap between *current* and *designated* identities. In Esme's story we see that the gap between current identities at the beginning of Grade 10 and the designated identity that learners should become mathematically competent problem solvers is large and learners choose not to participate. Designated identities of becoming "competent mathematical problem solvers" are skeptically considered by learners as euphemisms for "mathematical dummies" needing an extra three years to learn basic mathematics.

With a concrete focus on developing learner confidence, constantly encouraging participation and telling new stories about learners' mathematical thinking (e.g., "That is not a stupid idea—in fact it is helpful in solving this problem, tell us more."), current identities begin to shift. Learner talk changes from "I can't" to "I can or at least I'll try," and the gap between *current* identities and *designated* identities begins to sit in productive tension and stimulate mathematical learning.

Esme's story tells of her deliberate and explicit rejection of negative stories and her focus on encouraging participation in the caterpillar stage. This provides the momentum and space for her learners to reauthor their mathematical identities. Indeed, the supportive classroom community created by Esme and her focus on developing mathematical confidence in learners was important. There were, however, several features of the subject ML *per se* which enabled this story to unfold in a way that was different from Esme's experience of teaching "Mathematics" in earlier years. These curricula features are discussed below.

What Curricula Features Support "Living Different (Mathematical) Stories?"

The learning process resulting from the implementation of a curriculum is clearly complex with a multitude of factors impacting on the nature of learning. However, there are various features of the ML curriculum that Esme and learners in this school highlighted as opening the space for prioritizing participation, negotiation, sense making and "preparing learners for life." Table 35.2 identifies several features of the subject that support the emergence of new mathematical teaching and learning stories. While each feature is tabulated separately, they are, of course, complexly interconnected.

[2] Sfard and Prusak do not use the term *current* in their 2005 paper but instead refer to *actual* identity. This term can be misleading. In a personal e-mail correspondence with Sfard in November 2008 she wrote "I decided to replace the term 'actual identity' with 'current identity'. It is just that for some readers, the term 'actual identity' sounded as a declaration." In order to avoid this interpretation for readers of this chapter I too have avoided using this term and have therefore replaced it with the preferred term suggested by Sfard.

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Table 35.2 Curricula features that open up new spaces

Curricula feature	Space for new teaching and learning stories
Progression is located in the complexity of contexts with less mathematical "content" covered. From one grade to the next mathematical contents are often repeated with the recommendation that they are explored "in more complex contexts."	Less vertical progression enables slower pacing and increased discussion. Learner centeredness is noted and contrasted to mathematical teaching where the pace is set according to stronger learners in order to "get through the curriculum." Esme: "I am the facilitator and not the teacher, emphasis on understanding concepts rather than being driven by completing the syllabus…More relaxed slower pace…Structure is more informal, cooperative learning."
A focus on contextualization and the use of scenarios.	Exploring various real life contexts and scenarios necessitates discussion and participation in order to make sense of situations, and furthermore brings a personalization of learning, as multiple perspectives are part of the sense making process. Collaborative ways of working are productive of learning (contrasted by learners to group work in Mathematics requiring copying a student "in-the-know"). Contextualization (as well as the "newness" of the subject) also positions the teacher as a colearner and facilitator of discussion rather than the authoritative source of knowledge—opening the space for a more distributed locus of authority in the classroom community. Esme: "We're on a journey together."
A focus on ways of being and acting in the world (supported by an underlying socio-cultural learning theory).	This encourages teachers to focus more holistically on learners and their learning—participation, forms of participation and personalization of learning are of primary importance. Esme: "(Interaction with learners) is stunning—they are real live people and not just a vessel to fill with maths."
Explicit stipulation that ML is not for learners who intend to pursue "mathematically related" studies leads to commonality in learners' trajectories into life and/or non-mathematically related studies.	The explicit departure from preparing learners for further mathematically related studies opens the space for teachers to focus on mathematical engagement necessary for preparing learners for life. Esme: "You know there are a whole lot of things: blood alcohol levels, that is where they are at, teenage pregnancies…it's so important to their lives."
ML is a new subject defined as different to Mathematics. It is explicitly stated that it is not a watered down version of Mathematics.	The "newness" of ML distances teachers from their own apprenticeship experiences of mathematics teaching in their own schooling. This frees them to explore new ways of being in the classroom. The initial absence of external assessment precedents removed the tendency to "teach toward the exam" and supports the focus on learning rather than assessment. Esme: "(The curriculum is) wonderful, allows creativity and freedom to explore, invent, discover for yourself what works, how it works."

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As seen in the Table 35.2, various curriculum features work in tandem with teachers' interpretations of the curriculum to enable the development of a supportive community where learners can live and tell a different (mathematical) story and find support in the "subculture" of ML learners. Our story has highlighted learners' opportunities for developing new identities in relation to mathematics and the development of some level of competence and success with mathematical participation both inside and outside the mathematical classroom. But what of the quality of the mathematical learning?

Throughout learner interviews a personalization of learning was evident. Learners' noted that they could both bring their "life" experiences and their opinions to the learning process and extend their classroom experiences into their life. Thus, the boundary between the ML classroom and the world outside was increasingly experienced as permeable with increasing coherence between one's ways of participating and negotiating, being and acting in the world and in the classroom.

Several learners gave examples of how they used the mathematics learnt in class outside of the classroom. For example, one learner spoke of how for the first time he discussed with his father (an architect) the plans of a project he was working on, another explained how she helped her mother (an interior decorator) draw up the plans for redecorating her brother's bedroom, and so on. This, in addition to the strong performance of the majority of learners in this school (85% achieved "outstanding" or "meritorious" results), points to the quality of mathematical learning.

So why did learners experience this in ML and not previously in Mathematics? Overwhelmingly, learners' reasons centre around the nature of participation and engagement afforded in these ML classrooms. Learner comments primarily linked the reasons for this to their changing participation in the classroom in relation to two factors: "real" collaboration and "real" problem solving.

The "realness" of the collaboration and problem solving related to the similarity to real life—opinions and multiple methods are both valued and productive of both mathematical and contextual learning and the nature of the scenarios are messy. ML requires active participation, engagement and negotiation. The freedom to engage with the "messiness" of scenarios and negotiate the way forward without searching for "the right way" opened a learning space that was previously closed in mathematics classrooms. Learners also noted that the nature of engagement with teachers was different and that there was greater independence from the teacher as a result of having their opinions count and influence the direction of the lesson: "I think I understand it more because you like discussing with her… You are not just sitting and just listening to the teacher babble on you actually taking part."

As Esme said, in the butterfly stage, learners became mathematical negotiators. Wenger (1998, p. 210) writes that negotiability can be described with phrases such as: "opening access to information, listening to other perspectives, explaining the reason why,…inviting contributions,…opening decision processes, argumentation, sharing responsibilities…" Indeed, visits to Esme's classroom revealed that these were strong features of her classroom.

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Discussion and Conclusions

The story we have told illuminates a mathematical metamorphosis with respect to identity. From the writings of all of the 2008 Grade 12 ML learners in this school, it is clear that for each her/his mathematical story changed substantially as a result of participation in ML. Thus following our use of a narrative definition of identity we have illustrated the subject's potential to support the development of more positive mathematical identities. Learners in this story changed from mathematical outsiders, strugglers and nonperformers to active mathematical participators in their ML classrooms and in the world outside the classroom. We have also highlighted aspects of South Africa's ML curriculum which opened the space for such metamorphoses to occur.

This said the introduction of ML is not without some serious problems and challenges. While there are many other teachers and learners who tell similar stories, including in inner city state schools (see Venkat and Graven (2008) and Graven (2009)), there are also those who find it difficult to teach (and learn). Furthermore, now that the first national Grade 12 exit examinations were written in November 2008, the validity of the assessment of the subject (and with it the quality of the subject) is being called into question (see Jansen 2009a). Differences in perceived validity result in some universities accepting a good result in ML for business- and commerce-related studies while others do not. Entrance criteria are constantly reviewed in relation to stories that circulate about the quality and validity of ML and to debates about access to Mathematics. Racial inequalities in terms of access to scientifically related studies are perpetuated when many state schools only offer ML and not Mathematics to Grade 10–12 learners.

In a recent doctoral study, Sidiropoulos (2008) found that ML teachers she surveyed identified several problematic themes in relation to the implementation of the subject:

1. A threat to the status and identity of mathematics teachers required to teach ML. (Teachers view teaching ML as "inferior" to Mathematics and a demotion from mathematics teaching.)
2. A lack of leadership in ML, as Heads of Department, mostly, do not teach the subject.
3. Thin and disconnected levels of understanding the teaching of "mathematics in context."
4. Many teachers believe the curriculum is too difficult for the learners doing the subject.

The fourth theme emerged from her survey with public school educators. Since ML is a compulsory alternative to Mathematics, some learners enter Grade 10 ML having not managed the mathematical knowledge and skills required in the earliest grades of schooling. This problem is exacerbated in poorer public schools where teacher-learner ratios are higher and access to resources is limited. In contrast, Sidiropoulos' study found private school teachers did not hold this view and instead

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these teachers made reference to the value that ML added in terms of its benefit for learners' everyday lives.

This difference in Sidiropoulos' (2008) finding between public and private school teachers is particularly worrying in the context of a post apartheid South Africa where the introduction of ML aims to increase mathematical access for *all* learners. As Reddy (2006) so aptly points out in her paper on the state of mathematics and science education—schools are not equal—and the success of new curriculum innovations will therefore differ across schools.

Problems with the implementation of ML must be engaged with and large-scale national research is necessary to contextualize and make sense of these difficulties and to find solutions to them. Our fear is that success stories of the *potential* of ML to meet its aims might be overshadowed by stories of difficulties relating to implementation. Such difficulties are clearly problematic but one should not simply reject the value of this curriculum as a result of these difficulties. Instead, these difficulties should be solved so that the stories of these learners can become the dominant stories of learners across the diversity of schools and contexts in South Africa.

As Reddy (2006) points out, creative interventions often lack the detailed implementation plan and can then be abandoned when they do not produce the expected results. She warns: "We should not move from one intervention to the next and become 'serial innovators'" (p. 412). We hope that our story contributes to raising awareness of the *potential* of this subject to increase mathematical access to quality learning for those with previously negative mathematical histories.

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