CREATING AN ONLINE LEARNING ECOLOGY IN SUPPORT OF MATHEMATICAL LITERACY TEACHERS

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Abstract: The introduction of Mathematical Literacy (ML) as a compulsory subject for all learners in the South African Further Education and Training (FET) band who do not take Mathematics, created several challenges for teachers of this new subject. ML teachers struggle with a variety of issues ranging from lack of adequate training, diverse textbook interpretations, differing philosophical views on the importance of context versus content, negative parent and learner perceptions, assessment, diverse multilingual and multicultural settings and a lack of resources, to name but a few.

This paper will give a short background of some of the issues, as well as report on the difficult journey through technology in the quest to establish an online ecology of learning for mathematical literacy teachers.
1. INTRODUCTION AND BACKGROUND

The implementation of Mathematical Literacy (ML) as a new subject for the Further Education and Training (FET) band in South Africa in 2006, presented teachers with daunting challenges (Brown & Schäfer, 2006:45, Bowie & Frith, 2006:29). Not only are teachers expected to make this new subject accessible to their learners, but they also have to be “interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists” (DOE, 2003). In this paper I will reflect on my online intervention aimed at helping teachers cope with the implementation of this new subject and specifically focus on the use of various online tools used to make the intervention a reality. I will start by exploring some of the issues as expressed by teachers during training workshops, user group meetings and in online discussions within the online ML community (ML CoP, 2006_2007).

1.1 Defining mathematical literacy


1.2 The ML minefield

ML is currently offered as a compulsory alternative for learners who do not want to take Mathematics in the FET band in South Africa. It is therefore taken by all learners who previously would have chosen standard grade mathematics, or who would not have taken mathematics as a FET subject at all. Christiansen (2006:10) states that one of the reasons for the introduction of ML, is to “reach the 200 000 learners leaving grade 12 every year without mathematics and the 200 000 additional learners who fail mathematics yearly”. It is therefore predicted that the majority of learners will be studying ML in the FET phase (Mbekwa, 2006).

When dealing with this new generation of ML learners, teachers have to overcome numerous obstacles. They report that most of the learners in their ML classrooms constitute the “weak learners” who have a negative perception of what ML is (ML CoP, 2006). Learners’ perceptions seem to be that ML is “maths for people who can’t do maths”. (Venkatakrishna & Graven, 2006:26) and teachers report that they are therefore faced with problematic behaviour as learners view themselves as inferior. Some of the
learners could even be suffering from dyscalculia, a learning disorder which makes it difficult for learners to comprehend “numerical and spatial information”. Diagnosing this disability can be an intimidating task (Radmaste, 2006:42; Adler, 2001). Teachers want to know how to deal with these “weak” de-motivated learners, their perceptions and the barriers that they may be experiencing.

At the same time, teachers are at the receiving end of a strong parent resistance to ML as a subject choice for their children. Many parents feel that it will act as a barrier to tertiary education. As the first university intake of learners will only occur in 2009, tertiary institutions have been hesitant in clarifying to what extent ML will deter student admittance to certain faculties like Commerce, Law and Architecture. For this reason, many learners are forced to take mathematics instead of ML. Teachers also have to cope with negative parent perceptions and no clear guidelines to assist learners with their subject choices.

Furthermore, teachers are trying to orientate themselves with the mathematical content within the new contextualised nature of ML. They are battling with the question of whether mathematical content should be embedded within contexts or the other way around, a concern expressed by Venkatakrishnan & Graven (2006:14). Even ML material and textbook authors are confounded by the “content-context” debate (Bowie & Frith, 2006:29), which in turn affect teachers’ use of textbooks and material, another issue causing anxiety for teachers.

The diverse contexts and differing perspectives expressed by textbook authors present teachers with a difficult choices when it comes to selecting a textbook for use by their learners. Apart from the few recently published textbooks, there are hardly any contextualised resources available for ML teachers. They are using these available resources to set tests and assignments, which could also expose them to copyright infringements. The real challenge for ML teachers is therefore to develop their own materials with limited time, knowledge and technical skills at their disposal.

The real life contextualised perspective that is associated with ML, also calls for a multicultural as well as a multilingual approach to pedagogy. This in itself presents a conundrum for teachers who have to deal with the context in which their learners experience their world and make that accessible to them, using language as a medium. Most teachers and their learners deal with presented contexts in their second or third languages, which can create contextual interpretation problems in which the mathematical content may be obscured. Another question posed by Julie (2006:7) is how to choose contexts that will appeal to all learners, irrespective of their cultural background, that will constructively engage them in learning activities. Teachers also expressed concern about how linguistic and cultural diversity could be accommodated in external assessment tasks (ML CoP, 2006-2007).

Assessment is another source of anxiety for many ML teachers (Macmillan, 2006). Assessment tools, both summative and formative, have to conform to the new learning levels and learning outcomes. While learning outcomes are easily assessed, the
allocation of learning levels seems to be a more difficult and subjective exercise. that even experienced teachers are struggling to balance their assessment tools. Considering that we are in the second year of implementation, there are limited existing benchmarks for assessment and practices.

Teachers’ practice of ML demands that they have to take on the role of learners in coming to grips with the new concepts and learning outcomes that have been introduced into the FET curriculum, before attempting to facilitate the learning process for their learners. The principles of Outcomes Based Education (OBE) demand that teachers create rich, challenging and stimulating learning environments that are learner-centred and that take different learning styles and thinking levels into account [Department of Education, 2003a]. This calls for the development of new interactive learner centred resources, as well as the adoption of new approaches to the teaching and learning of Mathematics. Even though most teachers have undergone generic, as well as subject methodology training, teachers and principals felt that not enough time was spent on familiarising themselves with the actual subject-specific ML content and how to apply the content to a variety of real life contexts (Rademeyer, 2006). Teachers who have never taught mathematics are now being redeployed to teach ML, due to the shortage of ML teachers (Mbekwa, 2006:23). These novice ML teachers have to be learners and teachers at the same time, sometimes without a mentor, or the appropriate training interventions, to assist them when they experience difficulties with ML content. One teacher described this as “the blind leading the blind.” (ML CoP, 2006-2008). Teachers who interpreted ML as a watered down version of mathematics, are now starting to realise that it is as demanding, if not more demanding, to teach, and just as challenging for the learners to learn (Brombacher, 2005; Julie, 2006:63).

It is clear from the preceding discussion that many challenges face the introduction of ML in schools and that teachers need support in the implementation process. This paper reports on the use of a design experiment to create an online intervention which is aimed at addressing the practical problems experienced by ML teachers in their classrooms as well as enhancing their personal learning journey while implementing ML. The intention of the online intervention was to create a ML community of practice (MLCoP).

2. THE THEORETICAL FRAMEWORK

Teachers have to construct meaning from their everyday experiences as seen from their own perspectives, problems, contexts and backgrounds, which place our research within the interpretivist paradigm. Henning, Van Rensburg and Smit (2004:20) points out that this paradigm reflects a “communal process, informed by participating practitioners” and contributes towards a knowledge system that makes sense to the teachers involved. Vygotsky’s social constructivist theory of knowledge further illuminates the social
learning factor of this research as “individuals create meaning through their interactions with each other and with the environment they live in.” (Kim, 2001: Online).

Situated cognition provides a comfortable vehicle for assisting teachers to acquire the knowledge and skills needed to teach ML in their classrooms. Collins (1988, as cited by Brill, 2001) states that situated cognition can help learners understand the conditions for applying knowledge, by learning in novel and diverse situations and settings that provides optimized conditions for problem-solving and invention. It forms an integral part of a Community of Practice (CoP) and we will therefore draw from Lave and Wenger’s (1991:35), description of learning as a generative social practice in the lived-in world.

2.1 What is an online Community of Practice?

A CoP, according to Wenger, McDermott and Snyder (2002), consists of “a group of people who share a concern, a set of problems, a passion about a topic and who want to deepen their knowledge and expertise in this area by interacting on an ongoing basis”. McDermott (1999) points out specific characteristics of a CoP, which may be helpful in the context of ML, namely to help teachers deal with the practical day to day aspects of ML teaching, the problems they face, changes and transformation, as well as “share things that work and don't”. Havelock (2004) states that learning communities are about “sharing meaning, identity, and growth”. He also states that knowledge networking within these communities can provide teachers with trusted, socially acceptable examples of best classroom practices and reduce feelings of isolation experienced by most teachers in traditional classroom settings.

I wanted to investigate how an online intervention can support ML teachers in that it creates a virtual space where teachers can support one another as a CoP, exchange resources, and share tacit knowledge and experiences. Considering the diverse mix of teachers across two examination boards within our national educational system, an online computer mediated CoP can potentially make it possible for teachers nationally, to engage with each other regardless of space and time.

2.2 Designing for a Learning Ecology

An ecology, in biological terms, describes the ever evolving relationship and interaction between organisms and their environment. A learning ecology, according to Seely Brown (1999), is constantly evolving and relatively self organising. One of the goals of a learning ecology is to create knowledge. Teachers share both their explicit knowledge as well as their tacit knowledge. Seely Brown and Duguid (1998) explained that explicit knowledge is the “know-what” and tacit knowledge the “know-how” of knowledge that can be shared. Knowledge sharing is therefore not only embedded in the sharing of content, resources and information, but also in the sharing of how individual teachers experience their teaching of the content, the challenges they face and how they cope with it. Teachers can learn from each others’ stories by “learning over each other
shoulders” (White, 2007) and can develop skills which can assist them in their classrooms.

A design experiment, as a methodological means, provides a useful framework for this ecological study. It was first coined by Collins (1992) and provides a systematic way to design, implement and evaluate “educational interventions” (programs, processes and products) as solutions for complex problems in educational practice (Plomp, 2006). In this case my goal was to develop an online platform, where ML teachers can join, participate and create their own learning ecology, using the chosen online tools. This experimental approach makes it possible to not only study the effect of individual elements in a controlled environment, but to see how “tools, activities, and people mutually constrain each other…within a theoretical framework” (Hsi, 1998).

This ML learning ecology consists of two strands that impact on it, namely the practice of ML, as well as the use of technology, which makes it possible for teachers to interact online within the Learning Ecology and within the CoP. The iterative and reflective nature of design experiments makes it possible to evaluate the intervention and make necessary adjustments during the research intervention (Hsi, 1998). Figure 1 illustrates this iterative process.

![Figure 1: Iterative Design for a Learning Ecology](image.png)

The focus of this design experiment is to investigate how an online learning ecology consisting of a community of practice (CoP) as well as the online tools that supports the community activities, can address the real life problems that ML teachers are facing as they implement this new subject. The community is comprised of me as the researcher actively working alongside the teachers. The CoP is comprised of active and non-active
members (lurkers). Lurkers are members who do not actively participate, but are learning “in the background” by reading other active members interactions in the community. This is called “legitimate peripheral participation” as described by Lave and Wenger (1991). Members could be novice teachers, experienced teachers, material developers, textbook publishers, other researchers, ML experts, non governmental organisation personnel, learning area managers (curriculum advisors) and other interested parties. As ML is a new subject, the active members could potentially be drawn from any of the previously mentioned groupings. Moderators are volunteer teachers from within the community. Group membership is restricted to previously mentioned groupings only. This restriction is in place to make it possible for teachers to discuss tests and examinations without fear that learners will be in on the act. Once one of the moderators of the group has approved a member, this member can interact freely within the group.

3 PHASE 1 OF THE DESIGN EXPERIMENT
To ground my design in research guidelines, I used Stuckey’s(2004) Meta –analysis framework of elements, guidelines and principles for Internet- Mediated Community of practice development (IMCoP) as it tied in most appropriately with the goals of my design experiment and teacher based community.

3.1 DESIGNING THE INTERVENTION
My goal was to design an effective online learning ecology that could sustain interaction within the ML CoP and grow alongside the needs of the community. My role was to not only propose and create a workable structure but also to facilitate interaction as well as provide assistance to teachers in the use of the chosen technology tools. Figure 2 represents the bigger picture of the learning ecology where all the elements interact and impact on one another within the scope of a design experiment. It also illustrates how the knowledge created by the community can contribute to new knowledge, thereby contributing to the theoretical framework. Artifacts produced by the community can be used to influence teaching practice in authentic classroom settings. (Barab & Squire, 2004)

Figure 2: Design for the creation of a Learning Ecology
3.1.1 Choice of technological tools

While Stuckey (2004) urges that we “form communities around people and not applications”, the technology tools make it possible for the members to interact in the online CoP and make the online sharing of knowledge possible (Siemens, 2003). During phase 1 of the design experiment we created a static website (www.mathsliteracy.co.za) as a general ML informational area where teachers, parents and other interested parties can get basic information regarding ML. It also serves as an entrance platform into the CoP for ML teachers and houses important ML policy documents.

A File Transfer Protocol (FTP) server at ftp://ftp.mathsliteracy.co.za provided a secure site, where the group moderators can upload files for later retrieval by the teachers. The group itself was conducted in Yahoo groups, a free online e-mail distribution group, with facilities to upload and download artefacts, created by the members of the group. It also facilitated the creation of polls, photo galleries and a threaded collection of all the e-mails sent to the group.

Members could post messages online at http://groups.yahoo.com/group/mathsliteracy or send e-mail directly to the group using the e-mail address mathsliteracy@yahoogroups.com. All the messages were then distributed to the rest of the group as individual messages or in a daily digest. This formed part of an asynchronous discussion, where teachers can reply at their own time and contribute to the conversation.
Other online tools which formed part of the community during the first phase was Internet Messaging (IM), which allowed members to communicate “real time”, in a synchronous way, typing messages to each other or “chatting”. We also used Windows Live Messenger (WLM), Gabbly, Yahoo Messenger (YM) and Skype, a tool which allows for voice interaction as well. Both WLM and YM allow for the uploading of files for discussion during synchronous sessions and members on both systems were able to communicate with each other. Gabbly is a handy JavaScript tool that allows users to chat without the need to download and register for additional programmes. All these programmes are available as freeware downloads and lately even as web based platforms.

Apart from the online tools, teachers can also create artefacts using traditional offline software tools like word processors as well as presentation and spreadsheet software. They can use communication tools like faxes, telephone and mobile phones to keep up to date with important news and events relating to the ML community. More online tools (like Wikis) will be introduced as part of the design experiment at a later stage to facilitate more streamlined collaboration practices.

3.2 IMPLEMENTATION

The online community was first launched in July 2006 during a workshop at the Congress of the Association of Mathematics Educators of South Africa (AMESA, 2006) Teachers expressed excitement about having a space where they could share resources and ask for help with the implementation of ML. The online community, however, did not start growing until the beginning of 2007. During this time we consulted experts in the field of ML teaching, teachers and the Department of Education.

3.3 REFLECTION AND ANALYSIS: GROWING PAINS

Given all the issues surrounding the implementation of ML and the teachers cry for help and resources, we envisaged the online community to be a huge success and a vibrant community of practice. This (to our horror) did however not materialise and we were disappointed by the lack of uptake and participation by the teachers. This could be attributed to various factors, which we will now discuss.

3.3.1 The tools did not fit

In the first phase the Yahoo registration process constituted a major obstacle to becoming a member of the ML CoP. In order for the teachers to become part of the ML Yahoo group, an existing e-mail facility was needed to activate their Yahoo account. Some teachers did not have their own e-mail facility or access to their e-mail accounts, which resulted in them joining the group but not being able to activate their membership. The process also involved a double registration procedure, firstly for Yahoo groups and then the ML group. In the case where teachers did not have an existing e-mail account, they also had to register for one with a free web mail service on...
the internet. Teachers reported that the three lengthy registration processes were confusing and made it difficult for them to become part of, let alone participate in, the online community. In an effort to find a more user friendly interface, the Innovative Teachers Network (ITN), a new group tool provided by the national portal, Thutong, was used. It was abandoned after proving to be even more problematic. We then developed a tutorial with step by step instructions to address Yahoo registration problems.

Face to face workshops were conducted to try and get the teachers registered on the online community, as well as assisting them to become comfortable with the tools, in a supportive environment. The workshops were well received, but also highlighted other technological barriers. Teachers cannot type as fast as they can talk and this resulted in ML issues being discussed offline instead of online. They did, however, agree that they could, in their own time, share issues with a broader teachers’ community, no matter where they find themselves. Teachers who were present at these workshops started taking quite an active role within the online ML CoP.

In order to create a sense of community, virtual meetings and even a virtual “tea party” was scheduled, using WLM. Again, the download and registration process proved to be problematic. We also tried Gabbly, which adds a chat window to any website without having to register or download a programme. Unfortunately, it proved to be unstable and teachers could not always “see” one another. We then tried Skype, a Voice over IP (VoIP) programme, which can be downloaded and installed on teacher’s computers. Again, the teachers found it difficult to do any such installations. Chat programmes are banned by most school networks, which can also prevent teachers from engaging at schools, unless system administrators provide access. The use of IM did, however, result in some of the teachers communicating and collaborating with each other on a daily basis (Back channeling), forming a core of active community members. Even though this backchannel communications supported sharing and learning, tacit knowledge (all the valuable “how I teach” and “the problems I face” stories), were not shared with the broader online CoP. One way of overcoming this obstacle was to make transcripts of individual discussions available online to the rest of the community. The teachers did not always feel comfortable in allowing their private conversations about ML to be shared with the wider community.

They also experienced huge obstacles in accessing the Yahoo group and resources. They could not remember their usernames and passwords and retrieval of this information from the Yahoo platform, was cumbersome and prohibitive. The system also periodically blocked some teachers e-mail to group. Most school networks would not allow ftp access to the resource archive which caused frustration when teachers wanted to retrieve resources.

Quite a few of the teachers admitted to having an issue with the use of computers. They described themselves as technophobes and relied on learners, children and spouses to
access resources in the community, which did not encourage community building, collaboration and discussion.

3.3.2 The ‘Time’ factor
Teachers’ main complaint was that they did not have time to engage in the community. They mainly used the community to access resources and did not feel that there was any need for discussion. This in itself constituted an enormous problem. Most of the earlier resources did not conform to the Assessment standards as dictated by the learning outcomes for ML and needed discussion and clarification. The hope was that even unsuitable resources could be used to clarify issues and develop understanding for the subject. Without discussion, these resources could potentially re-enforce bad teaching practices and misconceptions. We then moved some of the unsuitable resources to a “dump” folder with the understanding that it could only be released into the rest of the community if it has been discussed first.

Some teachers also complained that the vast amounts of e-mails were wasting their time and they were only interested in resource sharing. Others reported that even though they were lurking, it gave them a feeling of connectedness.

The active members in the group also reported time management as a major obstacle in their active engagement in the group. Some group members felt that they were carrying the group. As we had no way of measuring the “participation” of the lurking members it was difficult to tell what impact the community had on the everyday practice of member ML teachers.

3.3.3 Lack of diversity
Most of the members seem to be teaching at either private schools or previously advantaged schools. This is not surprising as access to internet connectivity is a real barrier in South Africa for most teachers from previously disadvantaged schools. It does, however, not give the global view of issues experienced in the ML implementation process.

4 PHASE 2 OF THE DESIGN EXPERIMENT
We then set out to address the problems we identified during the first phase. Some of the members investigated different platforms including Joomla and Moodle.

4.2 Design modifications
In May 2008 we decided to move the community to a more user friendly interface by creating a social network using the NING platform (www.mathsliteracy.ning.com ) This platform addressed some of the technical issues experienced by the teachers in as far as that it simplified the registration process as well as the discussion and upload of resources and gave the teachers control over what e-mail they would like to receive. It allows for file, photo and audio uploads, easy retrieval of forgotten passwords, the use
of widgets (small applications from third party applications which can be embedded in pages on the network) and feeds (small pieces of automatically updated summarised article headlines) which helps to maintain up to date information and interactivity. It also has a built in events manager, forums and blogs. As a chat facility on the network we have embedded a Cbox chat widget to facilitate synchronous discussions and meetings. The Yahoo distribution list is still being used for newsletters and as a way to summarise what is happening within the network.

4.3 Implementation

The initial uptake was slow, but the teachers reported that it was a vast improvement and that the network was far more user friendly and intuitive to use. Inviting new members into the network is effortless and membership has been growing exponentially. We have also installed Google analytics to track usage on the network which shows that the members are actively using the site, even if they are not actively contributing resources and participating in discussions.

4.4 ML practice and reflection

Teachers are starting to engage more freely in the online community by sharing newly created tests and exams, anecdotes from their classes and questions which they have about the subject itself. Various ML experts and examiners form part of the CoP and are providing guidance. The quality and quantity of resources has improved significantly from the first implementation year. Teachers have also started to submit resources in formats that can be electronically edited and re-used which act as a time saving mechanism. The new forum interface has made it possible to provide resource feedback as well as create a sense of community and involvement.

We engaged in one organised online meeting where teachers shared resources which were then discussed using the chat facility as well as the forum discussion. The online meeting highlighted some of the ML issues mentioned previously as well as the lack of communications within the education system regarding the dissemination of information regarding ML.

5. Conclusion

Our ML learning ecology has grown to close to 200 members since its inception. Teachers are reporting that it is a “life saver” and that they rely on the community for information and resources. A significant number of ML resources have been collected and teachers are learning from each other in an active and collaborative way. The goal, however, is to entice more teachers out of “lurking mode” and into becoming active participants in the creation and growth of the learning ecology.

Sharing their classroom experiences in the online environment, have not been easy for some of the teachers. Whether it is due to technological barriers or social inhibitions, the challenge remains for them to bring their “stories” online. One way of capturing all
these offline interactions will be to make them available online, using audio streaming. This, however, could result in bandwidth barriers. The new platform on NING provides for the upload of podcasts (recordings made with cell phones or other recording devices) and we intend to experiment with this facility more in future in and effort to see if it would facilitate teaching, learning and collaboration practices.

As there are so many ML issues to address, discussions in the past seemed to be fragmented in the online community. The new NING platform seems to provide an easier way to keep track of discussions and issues in a threaded way. A concern for the teachers is the “information overload” of receiving too many e-mails. NING provides a way for the teachers to decide which conversations they want to be part of.

Technological barriers are an obstacle to teacher participation. More should therefore be done to eliminate the difficulties experienced by the teachers. Face to face interventions as well as continued online support and mentoring must be used to provide a bridge between the tools and teacher practice.

Even though this online ML CoP is experiencing growing pains, it has already proved useful in providing teachers with support, information and resources. Reflection on teaching practice is starting to happen and as teachers find their place within this online space, a true knowledge ecology may be grown.

REFERENCES


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