PLENARY PANEL
THE CALCULUS OF SOCIAL CHANGE – MATHEMATICS AT THE CUTTING EDGE

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The aim of this plenary panel is to explore the idea of a Mathematics Education that is at the cutting edge and on the cusp/crest of making a difference, hence the title, “The Calculus of Social Change – Mathematics at the Cutting Edge”. This theme will be addressed by four panellists. In this introduction I give the rationale for the plenary panel and describe how it has been organised.

INTRODUCTION

My participation in mathematics education conferences began in 1994 in South Africa and in 1998 I attended my first international conference, PME-22, which was held in Stellenbosch, South Africa. Since then I have attended many international mathematics education conferences, notably PME, MES and ICME. I have continued to attend these congresses because not only have they created an opportunity to share my work but also allowed me to reflect on ‘why’ mathematics, what I am doing in mathematics, who I am in mathematics, why I do the research that I do and what the point of my research is in terms of shaping what happens in my country, my continent and perhaps in the world. These questions continue to trouble me especially when I attend international conferences, which sometimes feel like a contest somewhere on a glorious stage away from real life: A place where we, who are most privileged, come together to debate the merits of our epistemological positions and argue over semiotics. At the same time many children all over the world, especially in developing countries, are being failed by mathematics itself and thus declared failures in life. These are the very children who are also dying of hunger, poverty and disease while others loll in obscene opulence.

There is no doubt that my life has changed for the better simply because I studied and succeeded in mathematics at a time in my country’s history when it was unusual for people like me (black, woman, poor and relatively young) to do so. So I understand very well the argument that mathematics education plays a role in keeping the powerless in their place and shoring up the strong in positions of power. I can see it in my context – mathematics education remains the key discipline in the politics of education. Mathematics qualifications remain an accepted gatekeeper to employment and a better life, so it is not surprising that managing success in mathematics has become a way of controlling the job market. So the question is: What is our role as mathematics education researchers who understand all this? Do we continue to do business as usual? Is it possible to use our understanding of mathematics and the
mathematics of change as well as the politics of mathematics education to bring about some social change?

The need for social change is something that all mathematics education researchers would agree to and support. However, the fight for social change, regardless of the form the battle takes, is deeply imbued with emotion: Often we want to hear about the life changed, the child educated, the mathematics transformed and the poverty eradicated. We also want to be sure that we contribute to a cause that seeks to better the world, or that volunteering to serve a cause, giving one’s time, money, sweat and tears will achieve a positive impact, however small.

This plenary panel was organised in a way that cuts through the emotions and the mere talk and gets to answer a simple question: How can we create a school mathematics education context that is built on democratic principles? As researchers we critique easily, but this panel discussion is an attempt to go beyond critique and theorising to think deeply and engage with the challenges of effecting social change on the ground. I understand very well the limitations of dealing only with the practical as much as I understand those of only theorising, hence my attempt to ensure that the two interact to enable the PME community to re-imagine critical mathematics education in practice.

In his paper entitled, ‘Critical mathematics education for the future’, Skovsmose (2004) argues that while mathematics education can empower, it can also suppress, and while it can mean inclusion, it can also mean exclusion and discrimination. Mathematics education, Skovsmose explains, does not contain any strong ‘spine’, because it can collapse into forms of dictatorship and support the most problematic features of any social development, or it can contribute to the creation of a critical citizenship and support democratic ideals. The socio-political roles of mathematics are neither fixed nor determined. Both roles, and a range in between, of being a hero or a scoundrel, are available to be enacted through mathematics education. This possibility of creating a critical citizenship and supporting democratic ideals is what the plenary panel is attempting to attend to. It is a possibility of going beyond talking about the virtues of critical mathematics education and working on what it may look like in practice. I am aware that there are no straightforward procedures for ‘determining’ the functions of mathematics education, as they might depend on many different contexts in which the curriculum operates. However, the possibility explored by this plenary panel is inspired by the need to challenge mathematics education research to examine what ‘could be’ rather than focusing on critiquing, analysing, describing and exploring ‘what is’.

**WHAT IS THE PROBLEM?**

In preparing for this plenary panel, panellists were asked to participate in a simulation. They have been sent individual letters by a fictional retired mathematics education researcher, Dr Thuli Dlamini, who is familiar with their work and was active in PME before retirement. While Dr Dlamini is well travelled and has lived in different parts of Africa, she is currently based in South Africa and has made some money since she
retired from mathematics education ten years ago. She now wishes to use this windfall to set up a school. The four panellists were sent individual letters of invitation to serve as advisors to Dr Dlamini who needs specific advice on how best to run the school. Below is a letter that was sent to one of the panellists. Since the letters were individualised to speak directly to the research of each panellist, I provide only one example here. Despite their different backgrounds and areas of specialisation, all panellists were given the same scenario in their letters and they were required to respond to the same request from Dr Dlamini as indicated below:

Dear Prof Wagner

It is great to be in contact with you again after so many years since I left academia. The last time we met was during the PME conference in Bergen, Norway where you presented a research report entitled, Critical awareness of voice in mathematics classroom discourse: learning the steps in the ‘dance of agency’. Despite the fact that I am no longer in academia, I remain interested in Mathematics education, and have kept up to date of your work. The published conversation that you did with David Stocker entitled, ‘Talking about teaching mathematics for social justice’ (2007) caught my attention and reminded me once again of the excellent work that you do not only as a mathematics education researcher but also as an advocate and activist for equity and social justice in general and mathematics education. I was thus prompted to write to you with a request that you join a team of international advisors for a school that I am setting up in South Africa.

The school will have capacity for 100 Grade 8 learners in the first year and we aim to grow it by a 100 learners each year until we get to Grade 12 with a total of 500 learners in the school.

The school will cater for children from low socio-economic backgrounds in an area that is neglected in terms of educational resources, other services and infrastructure. Low levels of literacy prevail and the community is multilingual because of migrant labour and the legacies of colonial social engineering. Numerical and digital literacies are very uneven. Parents have had a poor school education themselves, some to only primary level, and rely heavily on teachers to educate their children.

The average monthly income of households in the area is US$300, cost of living is high because of the distance to the city, and access to high quality education is difficult and very few children achieve success in mathematics. And those who do matriculate at the end of their high-school careers generally have weak grades.

The location has been chosen because it is a frontier between rural and urban communities, with some prospects for employment in secondary industries and some mining enterprises. Transport is expensive and households have unreliable power supplies. Electricity is also costly. Households therefore rely on alternative sources of fuel at certain times of the month. Communication is by mobile devices, but with low specifications. Internet connectivity through private service providers is also expensive. Many households have television, but are confined to a small range of national channels.

Community education is offered by some NGOs, churches and clubs, but few local inhabitants have a post-school education. If they do, they tend to leave the area to seek better employment in the neighbouring town or head for the nearest city. High
unemployment levels are prevalent and the fickle informal economy is often the only means of livelihood.

I have specifically chosen this area as an appropriate location for the school to provide access to high quality mathematics education for the learners in a deprived region of the country which is potentially a reservoir of labour in a developing province. While the problem of out-of-school, primary-age children still exists in the area, the numbers fell substantially and what remains a serious problem is access to and success at high school level. This is the reason why I have decided that the school should start at Grade 8 level, which is first year of high school in this country.

Your role as a member of the international advisory board is to advise me on the following two issues I am struggling with:

1. How can I ensure that this school is built on democratic principles?
   - Given the context in which the school will be located, how can we deal with issues of learner selection? Whom do we select, how and why?
   - What should be included in the mathematics curriculum to ensure that they do not only have access to higher education in science, engineering and technology but that they are also socially aware?

2. What should the projected identity of the school be and how should it be constructed?
   - How can we engage with issues about what the learners are becoming as a result of being in the school?
   - How can the school deal with the challenge of constructing an identity that is not elitist in a context where success in mathematics is regarded as elitist?

Please send your advisory notes of not more than five pages to Prof Mamokgethi Phakeng by 20th March 2014, and be ready to present them to an international audience at the upcoming conference, ‘The Calculus of Social Change – Mathematics at the Cutting Edge’ in Vancouver during week of 14th July 2014.

Regards

Dr Thuli Dlamini

WHOSE PROBLEM IS IT?

As expected, the responses submitted by the panellists are very diverse – they range from critique to applause for Dr Dlamini’s endeavour. However, all of them raise complex political issues that Dr Dlamini has to confront. The responses highlight the difficulties of having to engage outside the comfort of research or academia, as if the problem of changing mathematics education at the grassroots level is not the problem of research or of academia.

Wagner and Valero begin their responses by telling Dr Dlamini what does not qualify to give advice which can or should be relied on.

I am not more than a researcher and my expertise is in researching, not in building schools. People who, in your country and many other countries in the world, have built schools in
areas of “disadvantage” have for sure expertise and extremely valuable understandings of this situation and the challenges you will face. I highly suggest that you listen to them carefully and do not get tricked by the legitimacy that researchers’ voice have in this society. (Valero)

Valero’s caution to Dr Dlamini is well meant, but Dr Dlamini’s request for advice was not so much about the building (bricks and mortar) of a school as about the social dynamics of the school and the politics of mathematics education in the school. Unfortunately, those who are in the business of building schools do not worry much about the mathematics being taught in the school they are building or about its projected identity. It is Valero and other excellent researchers whose work focuses on mathematics education and society who spend their time critiquing ‘what is’ and hence they are the relevant people to engage with when thinking about ‘what could be’, as Dr Dlamini is trying to do. The fact that Valero feels unqualified to do so is perhaps worrying for the future of mathematics education.

Wagner, in his response, struggles with whether he should accept or reject the invitation to participate. He says,

For me, it is important to decide whether I am willing to be part of a project that makes change in another culture. I am a creature of privilege: white, relatively wealthy, well-educated, male, and a citizen of a relatively safe and prosperous country. (Wagner)

If indeed ‘who Wagner is’, disqualifies him from participating as an advisor to Dr Dlamini then we have to ask what qualifies him to do the kind of research that he does, which in many ways gives hope to those who teach and learn mathematics in contexts of poverty and inequality. Wagner continues to explain his hesitation to participate as follows:

I worry about reproducing or resembling colonialist relationships. In particular, I would not want to be associated with a project that values the knowledge and experience of one group more than others. I ask myself how outside consultants can privilege local knowledge. (Wagner)

While Wagner’s concerns above are valid, he is ignoring the fact that Dr Dlamini selected him to be his advisor precisely because of his awareness of all these issues, and with the hope that in his advice he will ensure that what we know about colonial relationships is not reproduced. Sometimes the anxiety about repeating the colonial turn becomes an alibi for inertia, which in some cases ironically has the same effect.

Walshaw’s concerns are even more troubling because they are not about ‘who she is’ and ‘what she knows’, but about ‘what can serve as a guarantee of the production of an inequitable mathematics experience’.

Privately funded initiatives and policy incursions might heighten social awareness and seek solutions to the educational problem by introducing new initiatives, yet they cannot shore up the guarantee of the production of an equitable mathematical experience. (Walshaw)
So the question remains, whose problem is it? And why do we do what we do as mathematics education researchers?

It is curious that of all the panellists, only Halai does not raise concerns about the Dr Dlamini’s initiative. Is it because of ‘who Halai is’? Or perhaps where she comes from and where she is currently practising? Is it because of her epistemological assumptions or the theoretical framework? Halai’s stance may be influenced by the sense of urgency which is prompted by being in the situation every day and seeing how mathematics serves as the gatekeeper to participation in the decision-making processes of her society. Living in both Pakistan and Tanzania, I have no doubt that Halai deals with many instances of how access to participation in mathematics also influences ‘who will move ahead’ and ‘who will stay behind’.

**ORGANISATION OF THE PRESENTATION**

The plenary panel will begin with an introduction by the co-ordinator. The co-ordinator will introduce the problem that the panel discussion focuses on, the rationale and the manner in which the panel discussion will be conducted. The co-ordinator will then introduce Dr Thuli Dlamini who is the project owner and sponsor to whom the panellists will offer advice.

The panellists will then be invited to present their advisory notes to Dr Dlamini in front of the audience. In addition to presenting their responses to Dr Dlamini, the panel members will be required to respond to each other’s paper as follows

- Wagner presents his advisory note
  - Halai responds to Wagner
- Halai presents her advisory note
  - Walshaw responds to Halai
- Valero presents her advisory note
  - Wagner responds to Valero
- Walshaw presents her advisory note
  - Valero responds to Walshaw

It is important to note that the manner in which I have scheduled these presentations is informed by the content of the papers. The person requested to act as Dr Dlamini will be given the opportunity to ask questions throughout the panel discussion – these questions will serve to evoke a discussion among and spur the panellists to think beyond their papers and consider the challenge at the heart of the scenario. Members of the audience will also be given opportunity chance to ask questions and interact with the panellists in an effort to assist with Dr Dlamini’s challenge.

**References**

PRIVILEGING LOCAL CULTURES AND DEMOGRAPHICS IN THE MATHEMATICS CLASSROOM

David Wagner
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I respond to a proposal for a new school in rural South Africa, built on democratic principles. First, I reflect on my prospective role as an outsider giving advice in this context foreign to me. Second, I consider the nature of democratic mathematics teaching and learning. I describe my participation in an analogous context in Canada, a First Nations community. Third, I ask how selecting learners can be democratic.

I feel honoured to be invited to consult on this significant project. It connects with two experiences I have had. First, I taught grades 7-12 mathematics both in Canada and in Swaziland before starting graduate studies. The juxtaposition of those two teaching contexts helped me understand that both mathematics and pedagogy practices are culturally situated. This insight drove me to my research interests. Second, I have been privileged to participate in conversations about mathematics teaching and learning in First Nations communities in Eastern Canada. Such cross-cultural experiences have enriched my understanding of education. However, cross-cultural pedagogical relationships are inherently problematic.

DECIDING WHETHER TO PARTICIPATE IN A MULTI-CULTURAL ENGAGEMENT

Many mathematics educators from privileged contexts have taken on positions of guidance and leadership in contexts that are foreign to them—within their own countries and beyond. For me, it is important to decide whether I am willing to be part of a project that makes change in another culture. I am a creature of privilege: white, relatively wealthy, well-educated, male, and a citizen of a relatively safe and prosperous country. The project Dr. Dlamini proposes takes place in a community that has been marginalized in various ways. I worry about reproducing or resembling colonialist relationships. In particular, I would not want to be associated with a project that values the knowledge and experience of one group more than others. I ask myself how outside consultants can privilege local knowledge.

My conversations in First Nations communities have sharpened my critical reflection on the relationships at play in such cross-cultural interactions. Lisa Lunney Borden and I (Wagner & Lunney Borden, 2012) acknowledged the inevitability of power relationships that could be connected to colonialist histories but we agreed that there are greater dangers in avoiding cross-cultural relationships. Without cross-cultural interactions, which help us develop understanding of others and ourselves, we are doomed to stagnate in our present worldviews and positionings.
It is tempting to assume that I do not need to worry about colonialist relationships because someone from within the community has invited my interaction. Though the agenda comes from within the community, I know that any community comprises people with a variety of agendas. The history of colonialism in Canada reminds me that we ought not to assume that an individual speaks for his/her community. European settlers made agreements with First Nations individuals as if they could speak for the entire community, often to the detriment of the community.

DEMOCRATIC PRINCIPLES

The fact that the new school aims for democratic values helps me be confident that we can have good collaboration. When I think about democracy, I am inclined to think about the discourse I would like to see in the context. I ask: What kinds of conversation would I like to see in classrooms and elsewhere?

We are gathering our advice for the new school under the title *The Calculus of Social Change*. Calculus is described as the study of change so it is an apt metaphor for analysing change. With calculus we analyse change in the smallest possible increments to garner insight into the larger trend. Indeed, any large trend comprises infinitely many small changes. In the same way, I am interested in zooming into discourse practices in mathematics classrooms.

Even though we educators and planners are interested in larger democratic interactions, we need to pay attention to the smallest interactions in classrooms. I envision a new school that directs attention to democratic discourse at all levels of interaction. As students and teachers make connections to power dynamics in local micro-interactions within the classroom and school, larger societal interactions, and the many levels of interaction in between, students will discover what democracy looks like and develop skills for building and critiquing it. In this way, a democratic school might be a force for positive democratic social change. I do not know of any empirical evidence for this claim. I would like to see more research that makes explicit connections among discourses in small classroom interactions, classroom cultures, academic curriculum, school systems, regional political and social networks, and very large-scale discourses including gender and race.

CURRICULUM THAT SUPPORTS THE DEVELOPMENT OF DEMOCRATIC PRINCIPLES

This leads me to Dr. Dlamini’s question about curriculum in relation to democratic principles. What kinds of interactions would I want to see in the school’s mathematics classrooms? I encourage any school to guide its children to address explicitly the many levels of discourse I noted above and to make connections among them. In order to be taken seriously in the complex discourses that they will seek to change, the children will need to develop an understanding of the discourses as they currently exist. Thus I would promote curriculum that develops learners’ skills and knowledge that align with the curricula in other South African schools while also looking critically at this
knowledge, its structure, the cultures it favours, and the discourses that surround it. Thus there would be elements of traditional mathematics classrooms that ignore local culture, elements of radical mathematics teaching (e.g., Gutstein, 2008), and even critique of the whole structure of mathematics curriculum and its privilege (Pais & Valero, 2012). Derrida’s (1976) concept of erasure may help us envision the coexistence of these conflicting curricula.

The elders and other leaders in First Nations communities in which I have had conversations desired this approach to curriculum. The children of their communities need to understand and connect with the dominant discourses in the country and also understand how these discourses create and sustain conditions in their communities. With these two kinds of understanding, children can be equipped to stand up to and change unjust social structures in their communities and beyond.

Bakhtin (1975/81) used the metaphor of complementary centripetal and centrifugal forces to describe the way all utterances simultaneously draw in and lead away. When I address someone I have to appeal to shared meaning in order for my interlocutors to make sense of what I say (this is the pull toward the centre of conventional discourse) but I also refer to the conventional in order to make change and to push at its boundaries. He described the two forces in the metaphor as heteroglossic and unitary language. Other scholars have described the distinction using the terms open or closed dialogue. As Bakhtin noted, there would be evidence of both forces in any instance of interaction, but we should be attentive to which one is favoured. An important principle of democratic dialogue is that diverse views are voiced. In other words, open dialogue is necessary for democracy.

I characterize the field of mathematics education as one that promotes open dialogue in solving problems and developing procedures. Children should understand that multiple approaches are possible and that a new approach can produce new insights. For example, students should be given mathematical tasks that invite multiple approaches. Furthermore, research frameworks and pedagogical frameworks have been developed to draw attention to strategies that develop student autonomy. I consider it unfortunate that mathematics classroom practices tend toward closed dialogue in which children are not invited to see the possibility of multiple approaches and possibilities. Teachers too frequently fail to raise the possibility of students’ autonomy. The quantitative analyses of a large body of classroom transcripts that I have done with Beth Herbel-Eisenmann (Herbel-Eisenmann & Wagner, 2010) show that classroom dialogue is still markedly closed, at least in the context of the analysis. On the basis of my conversations with mathematics educators around the world, it seems that the nature of classroom dialogue is similar elsewhere.

This will be a challenge in the new school. Given that attempts to change classroom discourse practices have been difficult in other contexts—even with the overwhelming commitment to open dialogue among mathematics education scholars—how might the new school succeed in this endeavour?
To address this question, I want to tell you about my experience working in the First Nations communities mentioned above, because Lunney Borden and I noticed significant changes to discourse patterns as a result of some conversations in which we took part. The key to the change in the patterns of discourse seemed to lay in the fact that teachers gave students the responsibility to investigate their community. Lunney Borden and I had had conversations with elders and other honoured community members to identify mathematics in their traditional and current practices. The elders were very receptive to this ethnomathematical research, although they thought it was funny to think of their common sense as mathematical. Lunney Borden and I noticed that we would be positioning ourselves as mediators of knowledge between the elders and the community children if we passed the results of our ethnomathematical work to the children. We raised this concern with the elders and some teachers. Together we invented an event called Show Me Your Math, in which we invited children to identify mathematics in their community. Children were invited to talk with elders and investigate local artefacts to identify mathematics done in the community. They were also invited to identify the mathematics that the government uses to cheat their community. Lunney Borden and I saw three emergent qualities that aligned with community values (Lunney Borden & Wagner, 2011). First, cross-generational relationships were developed as children talked with community members about their practices. Second, the synthesis of community practices and academic mathematics adjudicated aspects of the colonizing cultures in terms of community values. Third, with this synthesis, the event supported holism for children as they were invited to bring together different aspects of their lives.

Some of the strongest critiques of ethnomathematics come from South Africa (e.g., Vithal & Skovsmose, 1997). Although I find these critiques warranted, I am reluctant to give up on the study of mathematics at work in cultures. I note that identifying political conflicts could benefit from mathematical analysis as well as from identifying ways in which actors in the conflict use mathematics to argue their cases. Identifying the mathematics in cultures of dominance is a form of ethnomathematics.

SELECTING LEARNERS FOR PRIVILEGE

In my view, the most challenging aspect of the proposed new school relates to ‘learner selection.’ I resonate with the term ‘learner’ because I am uncomfortable with the idea of calling children students, which would foreground one aspect of their experience and background other important experiences (the opposite of the holism I mentioned above). Teachers, administrators, and students are all learners, each with their own rich experiences beyond and within the context of the school. Careful selection of the participants will shape the nature of the discourse within the school.

In my research I have not focused on learner selection, probably because in my country (Canada) all children have the right to schooling and most schools are provided with good resources (OECD, 2013). The funding of schools in First Nations communities is a notable exception historically and presently (FNEC, 2009). However, the question of
learner selection reminds me of a girl whose father died in her last year of secondary school in Swaziland. Without his advocacy, her family refused to pay her school fees for her final months because they felt education was wasted on girls. Her experience suggests that the new school may need to seek out its students instead of relying on passive selection from applicants.

Choosing students for the privilege of schooling seems antithetical to democracy. I suggest that the school aim for a learner body that is representative of the people significant to the community in terms of demographics. In this way it may privilege individual participants but could help the school showcase possibilities for active engagement of the local demographic. I would hope to see both the student and teacher body include approximately equal numbers of females and males, representatives of the various national and linguistic backgrounds in the community, including a few with privileged backgrounds. I do not have experience with engineering such classrooms, but I suggest that conversations about community challenges (local and national) and their connections to a history of abuse by White people and to migrations of people would be enriched with the inclusion of White children, immigrant children, and a majority of community children with local roots. To the extent that the school showcases possibilities for democratic engagement with local issues including people representing local demographics, local concerns and local people and their values will be privileged.

References


Wagner


SOCIAL JUSTICE THROUGH MATHEMATICS EDUCATION: SKILLING YOUTH FOR SOCIETAL PARTICIPATION

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This paper responds to issues in offering a relevant, skills focused secondary school mathematics education in a multi-cultural, remote, poverty-ridden community. It is proposed that the mathematics education in the school could be structured within Fraser’s social justice framework of re-distribution, recognition and participation (Fraser, 2000). A mathematics education from a social justice perspective would reach out to marginalized learners and enable them to realize their goal of mathematics learning by skilling them for an active participation in the society.

SETTING THE SCENE

The case study under consideration of the panel raises several issues for a secondary school education that realizes the promise and potential of mathematics to leverage a community out of poverty. These issues include: low socio-economic background of the learners in the community; limited access to quality secondary education and uneven numerical and digital literacy among the learners; remoteness of the community from opportunities of employment; little exposure to media and internet; and the multi-lingual and multicultural nature of the student intake.

In the context of the issues above, two main challenges are posed to the panel: How can the democratic principles be incorporated in building the school, and what should be the projected identity of the school. To propose recommendations that are principled and pragmatic the case is located within a framework of social justice because social justice is a significant pillar of a democratic education concerned with inclusion in education of the marginalized sections of the community.

A FRAMEWORK FOR SOCIAL JUSTICE IN EDUCATION

The recent Global Monitoring Report shows that in spite of huge strides in providing access to basic education, access has not translated into positive learning outcomes, and education has not realized its potential in leveraging individuals and communities out of poverty, or addressing persistent social inequities on the basis of poverty, gender or culture (UNESCO, 2014). For example, consider the case of Tanzania in East Africa, where access to primary education has increased to 98% and secondary education is at about 49% (Tanzania Education Sector Analysis, 2011). However, the quality of education is in crises. A regional study of student achievement in literacy and numeracy found that in Tanzania “Only 3 in 10 standard 3 (primary school) pupils can add subtract and multiply [.] Only 1 in 10 Standard 3 pupils can read a basic story (Uwezo, 2011, p. 7).” Furthermore, the high stakes Form Four secondary school
national examination results for 2012, especially in mathematics evidenced huge failure rate of 65% leading to urgent national education reform (MoEVT, 2014).

It is certainly not the case that the young Tanzanian learners do not know any mathematics. Indeed the work for example of Paulus Gerdes (2010), shows that highly complex and sophisticated mathematics is embedded in the basket weaving and other traditional cultural practices embedded in the East African culture, bearing testimony to the mathematical history and potential of the learners in this community. However analysis of mathematics syllabus and practice in the public schools in the country shows that socio-culturally embedded mathematics knowledge is not a part of the syllabus, and the transition from Kiswahili as a medium of instruction in primary schools to English in the secondary schools poses conceptual and syntax related hurdles in learning (Kajoro, forthcoming). A high rate of failure in mathematics in secondary schools suggests among other factors alienation with the curriculum so that learners are not able to see the relevance and purpose of the mathematics they learn with their lives and prospects (Valero & Pais, 2011).

To conclude from the foregoing, access to education has to be seen in conjunction with the relevance of education for and with the community being served. This would entail a critical examination of the assumptions underpinning the purpose and relevance of education within a framework of social justice issues in education access.

Fraser, (2007) proposes a useful framework to make sense of the social justice issues in education with three key dimensions of social justice i.e. “redistribution, recognition and participation” (p. 17). This framework is usually employed with the country as a unit of change, to redistribute access to education across the socio-economic divide. However, the framework could be employed at the level of schools and classrooms where social justice issues are experienced locally (Atweh, 2009). For example, in the classroom, the teacher has the authority to ensure that the cultural capital is distributed to all learners for them to be able to learn effectively and succeed in school examination. Here, cultural capital is seen from Bourdeau’s perspective including forms of mathematics knowledge, skills and attributes that could potentially give the learners an advantage to succeed in mathematics (Bourdeau, 1977). Recognition of diverse needs of learners from various social and cultural contexts would require that the teacher acknowledges these diverse needs in the classroom, and creates opportunities for their optimal participation in learning.

However, participation is contingent upon recognition which is inherently political in nature because recognition demands that the larger social and cultural forces that are played out in the classroom dynamics are challenged to allow for the participation of the marginalized learners. What follows is a discussion of the three dimensions of social justice with reference to the specific issues in the case.

**Redistribution and Recognition**

Selection criteria and entry into the secondary school would need to be inclusive so that redistribution of the cultural capital is among a wider population and not just those
few who might have performed well in primary school. Beyond selection and entry, effort to re-distribute cultural capital would need to ensure that curricular processes recognise the diversity in the classroom. Recognition of learners who are marginalized due to socio-economic status, gender, language or other factors would mean questioning deep seated assumptions that underpin the organising structure and process of classrooms, in this case mathematics classrooms. For example, in patriarchal societies with roles defined on the basis of gender, teachers often subscribe to the dominant social and cultural views that boys are inherently better in mathematics thereby marginalizing girls in terms of participation in mathematics (Halai, 2011). In such situations “affirmative remedies” could reinforce the prevalent views and not questioning those deeply held cultural views which inhibit participation of both, boys and girls.

Redistribution of cultural capital in mathematics would take into account the requisite 21st century skills for learners such as, numerical, digital, problem solving and critical thinking skills. For skills development, process of teaching and learning in the mathematics classrooms would move away from routine memorization of procedures and algorithmic knowledge towards participatory learning involving application of mathematics knowledge to problems. Mathematics knowledge embedded in the history and culture of the learners would be a significant element of the cultural capital being re-distributed. This would socio-culturally embed mathematics learning and reduce alienation of learners with school mathematics (Gerdes, 2010).

**Participation**

Participation in mathematics learning from the perspective of social justice means that learners have a voice, and intellectual and social space to take part in the process of learning and achieve their learning goals (Atweh, 2009; Fraser, 2007). Learners’ identity is not that of passive recipients of knowledge dispensed by the teacher, they identify themselves positively as becoming mathematically proficient. The dynamics of the power relations between the teacher and the learners would need to change to position teachers and learners as co-participants in the teaching learning process.

**RECOMMENDATIONS**

Several recommendations are made for an education aimed at preparing learners skilled mathematically and digitally, for active participation in society, and leveraging their community out of poverty.

**Selection of learners**

In a context with limited access to secondary schooling, issues of learner selection are complex. An attempt to select on the basis of performance in primary school examination could exclude students who know mathematics embedded in their culture, experience and language because the standard school system is usually set up on the basis of an academic mathematics, encoded in a national/international language of instruction. Hence, selection of students should aim to re-distribute access through a
critical interrogation of any prevailing admission policy in favour of a multi-faceted admission policy that includes other criteria besides performance in primary school leaving examination. Other criteria could include demonstrated skill in application of knowledge of mathematics rooted in learners’ culture and experience. Beyond entry, affirmative action in the form of “bridging classes” in the afternoon could support learners requiring upgrading of numeracy and digital skills.

**Relevance of mathematics content and process**

Relevance of mathematics content and process is an important element of recognition of diversity in learners’ needs. Curriculum content in this school would need to go beyond the usual emphasis on Euro-western mathematics to recognize the mathematics rooted in the historical, cultural background of the learners. Pedagogic process would espouse social justice principles i.e. inclusive in terms of high expectations from all learners irrespective of their socio-economic background, culture or gender, and creation of space in the classroom dynamics for learners to participate in construction of mathematics knowledge (Valero & Pais, 2011).

Strategies such as *internship placement* could be employed for learners in mathematics to work on real mathematics problems in work-place situations in the local community. Recognizing the work place as a legitimate site and source of knowledge would also challenge the traditionally powerful position of the school as the sole site of knowledge.

**Teacher recruitment and professional development**

Appropriately qualified teachers would most likely not come from the local community that has a low level of education. Adequate measures for recruitments and retention would include liaison with key education stakeholder, and a system of rewards and incentives on the basis of a nuanced understanding of education quality that goes beyond the traditional focus on achievement in examination.

Teachers knowledgeable in mathematics, skilled digitally, and professionally competent would be crucial to re-distribute cultural capital in mathematics to the marginalized learners. Teachers would require regular mentoring to enable them to sustain their practice in highly challenging classroom contexts (Halai, 2006; 1998). School budget and policy would need to provide for regular professional development for mathematics teachers to keep them updated with new developments in the field. Given the remote location of the school it would be beneficial for mathematics teachers to become members of a professional association network.

**School community links**

School community links play a significant role in monitoring the quality and outcomes of education (UNESCO, 2014). A strategically formed board of advisors with members from the local community and the professional community including mathematicians and mathematics educators could support quality assurance.
To conclude, a secondary school in the midst of a highly disadvantaged community could strongly support the youth by skilling them to participate in the society and leverage their education to come out of poverty. However, it would have to be an education framed within the social justice framework as noted above.

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CUTTING THE CALCULATIONS OF SOCIAL CHANGE WITH SCHOOL MATHEMATICS

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Dear Dr Thuli Dlamini

Thank you for your invitation to be part of this panel of expert researchers to advice you forming your project of a new school. I appreciate the information provided regarding the context of the school that you would like to build and some of your visions for such a school. In my answer to your request, I would highlight different aspects of what we —myself and the group of researchers’ with whom I work— have to say about your initiative.

THEORY IS ACTION!

I am honoured that you had considered asking for advice from a researcher. I am not more than a researcher and my expertise is in researching, not in building schools. People who, in your country and many other countries in the world, have built schools in areas of “disadvantage” have for sure expertise and extremely valuable understandings of this situation and the challenges you will face. I highly suggest that you listen to them carefully and do not get tricked by the legitimacy that researchers’ voice have in this society. As a humble researcher, I am in no position to tell you what would work in practice. It would be extremely arrogant on my side to say that on the grounds of our research, my team and me could give you the key for success. In other words, I cannot offer you an “implementation” in practice of my research results, because I do not believe that such “implementation” is a straightforward matter that could effectively lead to a good school.

However, that does not mean that researchers have nothing to offer. The only thing I can offer is theory and analysis, and not more than that. And it is indeed the most powerful tool you could ever have in thinking your school. Politicians, administrators and researchers alike tend to think that theory is just a bunch of words that people like me, accused of never leaving the wall of the Ivory Tower of their universities, write and publish in high impact factor journals. Such a way of thinking may be connected with the historical division between mind (and theory) and body (and doing and action) at the heart of the rationalism of Western philosophy. In this way of thinking, thoughts and theories are enunciated but are not performed, and therefore are believed not to be action. Against this view I would argue, thinking with Foucault and Deleuze, that there is no more powerful practice than the practice of thinking and theorizing (Foucault &

1 Melissa Andrade, Gloria García, Gelsa Knijnik, Alexander Montecino and Aldo Parra helped me commenting and discussing a response to this invitation.

Deleuze, 1977). Theorizing is not contemplation. Theorizing is the very same political act of imagining what is not yet possible to imagine because of existing epistemological framings for practice. Theorizing as a critical practice means articulating the cracks of the truths of knowledge within which we innocently act. It is only in the cracks of the truth narratives that govern our action that we may find a new way, a possibility to be invented, a new language to be articulated and, with it, a choice to act for breaking existing forms of government and power. Therefore theorizing is action. It is a political commitment of the researcher—would rather say the intellectual, even if the word intellectual seems to have vanished in favour of the understanding of the educational researcher as an engineer. Without thinking seriously there is no change!

Allow me to interpret your invitation not as an advisory task, but rather as an encounter between the humble perspective of an intellectual and the hard work of you and the people who will set up your school. My intention will be that of raising questions on the ways it is possible to think mathematics education as part of the larger cultural politics of schooling in a country like South Africa, and how the practices that will take place in the school could fabricate the subjectivities of children through the functioning of the mathematics curriculum. My invitation is to a critical dialogue about the possible effects of the many good intentions in the foundation of your school.

**MATHEMATICS EDUCATION AND POWER EFFECTS**

Let me start by spelling out an assumption I depart from. Although frequently seen as the practice that transmits valuable knowledge, mathematics education is part of a power dispositif that governs the conduct of all its participants in desired directions. Seen in this way it is possible to connect the micro politics of educational practices with its different technologies within the larger politics of government in the state. In that sense, mathematics education is no other than political, and effects power through its organization of the population, the schools, the classrooms and the teachers and pupils as well. Such organization though, does not happen in a vacuum but is part of historically constituted forms of thinking about the self and the other. Elements of the theoretical position that I deploy in thinking your case have been developed in our recent work (e.g., Valero, García, Camelo, Mancera, & Romero, 2012).

Such theoretical position invites me to consider in a critical way some of the assumptions made explicit in your invitation to advice your initiative. In particular it calls my attention the idea of a school that explicitly empowers students with mathematics, and the issue of who the students will become.

**MATHEMATICS EDUCATION AND POVERTY**

With respect to “developing countries” such as South Africa, Brazil, Colombia or Chile—the countries where my collaborators and I have carried out research—high mathematical achievement is seen as an indication of national and personal progress. Such thinking makes desirable to “empower” children and the nation with providing
“democratic access to powerful mathematical ideas”. In the particular case of South Africa, you express your desire of empowering children in your school with mathematics. We need to place such desire in a broader rationality to understand why in the first place such intention is desirable, and to think which may be “side effects” that you may not have considered. Several researchers have argued that in South Africa mathematics education cannot be understood in isolation from the operation of the mechanisms of racial segregation installed by the apartheid regime, even nowadays, 20 years after the transition to democracy (e.g., Setati, 2005). The interesting thing is that the blunt exclusion of black population from educational opportunities, even in mathematics, is an extreme case of what seems to be the case in other developing—and even developed—countries. The documented low achievers in mathematics are children belonging to the groups positioned in the low ranks of a particular society. If this is the case, then we can say that low mathematical achievement evidences that a low socioeconomic positioning is strongly connected to losing in the game of getting credit and value through education. That national and international statistics evidencing such connection are not only the numbers that represent a social fact; those very same statistics and their production are an important element in the construction of the strong connection between low school (mathematics) achievement and poverty as a simple, unquestionable truth.

One of the effects of this truth and its associated ways of reasoning is the motivation of mathematics educators to put their good intentions and efforts in promising an empowerment of people with mathematics. This empowerment sometimes results in some stories of success. At least in Colombia, very few students attending a very poor school, even if they excel in mathematics, would make it out of poverty. And of course any story of success is a gaining because it means the realization of the promise of a brighter future, of social and economic mobility, for at least one individual and one family. However, the success of one or of few is only the success of one or few among thousands. It is not the success of the many. Why? All good intentions and promises of redemption with and through mathematics are subordinated to the ordering of power and differentiation in society. Education is a very powerful institution that classifies, selects, and grants credit to some and, at the same time, has to inscribe failure in others as the very same pre-condition for its functioning. In thinking this, I take the analysis that Alexandre Pais (2012) has been proposing when connecting mathematics education with the ideological functioning of capitalist societies and their power mechanisms. The narrative of salvation and empowerment with mathematics are part of the technologies of government that detract our attention from the fact that educational failure in mathematics is the very same condition of the ordering of power. In other words, the failure of many in mathematics is the precondition for the success of the very few. It is failure of the many what grants value to the few who succeed. If all, in reality all, could have success in school and in school mathematics, education would not be a central field of government and power.
MATHEMATICS EDUCATION AND THE GOVERNMENT OF SUBJECTIVITIES

You raised the question of how to avoid that mathematics be perceived by people in the as an elitist activity and how to harmonize it with democratic goals. My first answer is that it is impossible to detach school mathematics practices from a perception of elitism for various reasons. First of all, from the time of the Ancient Greeks, access to mathematics was the key element in the education of those with “gold in the soul” who in fact were the ruling elite of the polis (Radford, 2008a). Second, despite the expansion of arithmetic and further mathematics in massive educational systems during the 20th century, mathematics remains still the type of knowledge and the school subject that operates the selection of the “smart” and “intelligent” from those who are not. The association of mathematical ability with intelligence is part of the discourses circulating in popular culture, expressed in, for example, the views on who mathematicians and what is connected to their success (Moreau, Mendick, & Epstein, 2010). Third, achieving success in mathematics demands acquiring competence and fluency in a vertical, hierarchical code, which differs from the language codes of everyday life. Thus, those who can “speak the codes of mathematics” have gained a “rarefied”, specialized language that clearly breaks with the structure and relative “simplicity” of the everyday linguistic forms of communities (Jablonka & Gellert, 2011). Fourth, the adoption of hierarchical codes is not simply a new linguistic habit or a change in cognition. If objectifying as knowing is inseparable from being, as Luis Radford has postulated (Radford, 2008b), succeeding in mathematics is also a process of becoming subject. As we have argued before, the subject that school mathematics seeks to fabricate is the Modern, rational, cosmopolitan child (Valero et al., 2012). Becoming that child has a double effect in the governing of the self in relation to the power. On the one hand the technologies of mathematics education inscribe in children desired forms of thinking which make the child the desired subject for the political and economic organization of society; and at the same time effects a rupture between the child and the forms of reasoning of the communities they live in. The “(mathematically) educated child” becomes a subject breaks apart from his/her community and its forms of knowing and being. This rupture is inevitable. It is the very same condition of education.

DECENTERING THE CURRICULUM

As you can already notice, my analysis is not as optimistic as your intentions. Not being optimistic does not mean that such an initiative should not be realized. I simply want to make a strong point that no matter what we do in education, there are always power effects. The rethinking of (mathematics) education is not an easy task if a strong political concern is taken into consideration. The research that we have carried out in Colombia (García et al., 2009), in situations similar situations to the ones you describe, has taught us two important lessons. First of all, as part of the cultural politics of education, school mathematics practices govern children, effect classifications, and inscribe in them forms of reasoning about themselves. Such systems of reason both
include some who become the desired child for the dominant political and economic organization, and exclude others whose forms of life and being continue to be marginalized. Mathematics education effects power through the fabrication of children’s self, that is, their subjectivity. Secondly, as a consequence of the former, one possible alternative for the development of curricula is to articulate it around the construction of children’s subjectivity. While curricula have been traditionally organised around central mathematical ideas or competencies, an organization around children’s subjectivities displaces the core of mathematical concepts as the centre of the curriculum and opens the space for subjectivity to become the articulating axis around which mathematical forms of reasoning and acting could be organised. It becomes then possible to include other forms of being while also expanding the meanings of mathematics beyond the realms of a disciplinary core. In such a project being and objectifying become entangled in new ways that may be worth exploring.

We look forward to hearing about the advances in your initiative!

References


RAISING POLITICAL, PSYCHOANALYTIC, AND CULTURAL QUESTIONS OF A PROPOSED EDUCATIONAL INTERVENTION

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This paper provides a response to a proposal that seeks to make a difference to students in one location in South Africa. It raises troubling questions about how to change education in one setting in a way that is just as well as educationally and culturally meaningful. Comprehending the proposal through theory draws attention to political and psychoanalytic questions and the imperative to consider the future alongside the cultural present and past.

INTRODUCTION

The immediate response to the intention to establish a school in South Africa is that it feels like a welcome breath of fresh air. The proposal is both an instructive response and an emancipatory gesture to one of the most complex and pressing issues facing mathematics education in South Africa today. Aspirations that advocate for the rights of students to education carry considerable persuasion, particularly to outsiders from communities which experience universal free education. Viewed from the perspective of transition, development and progression, the proposed initiative represents a compelling emancipatory and utopian vision, promising to create a better balance amongst global communities. Interventions predicated on an interest in establishing new norms of educational relations, can at the individual level, it is believed, open up possibilities that enrich the student’s present and future, enabling the student to move beyond repressive practices and fulfil unrealised dreams, while, simultaneously, advancing the local economy.

A more considered response reflects on the serious challenges that South Africa is currently experiencing—challenges in relation to a repressed economic environment, dire poverty and the realities of multi-cultures, formed through space, place, and race as well as history and language. Moreover, these realities are nested within the tensions between the national and global economies, as well as between colonial and postcolonial educational cultures. In a context like this, the achievement of sustainable educational futures, like the initiative proposed, becomes exceedingly tenuous. The plan for innovation and reform in relation to the establishment of a school located at a frontier between rural and urban communities in South Africa weighs heavily in the balance.

Across longitudes and latitudes, from specific coordinates where every child does have access to mathematics education, I wish to underline the significance of the proposal on the basis that is forward-thinking and is organised around a belief that students on the wrong side of the social-capital divide should be given opportunities. But in a shift
in registers I wish to convey what Spinoza has named the unceasing challenge of the ‘not yet’. What precisely does lie ahead? Proposals are gifts but, as Derrida has cautioned, in their realisation, they produce events, new forms of action, new practices, and new forms of organisation. All these signal that the task ahead will not in any way be straightforward. Privately funded initiatives and policy incursions might heighten social awareness and seek solutions to the educational problem by introducing new initiatives, yet they cannot shore up the guarantee of the production of an equitable mathematical experience.

My response does not offer the magic bullets or guarantees that you might be seeking. Rather, it is more tentative, raising troubling questions about how to change the texture of the world in one setting in South Africa in a way that is just as well as educationally and culturally meaningful. The imperative is to consider the future, along with the present and the past. Comprehending these through theory might provide a sobering counterpoint to the promise of your proposal.

THE POLITICAL QUESTION

Without a doubt, the proposal demonstrates a large reservoir of hope. However, viewed from the perspective of post-critical theorists (e.g., Ellsworth, 1992; Lather, 1992) a project based on liberal democratic principles is fundamentally problematic precisely because a collective enterprise is always already operative upon and within the individual. Students, like their teachers, participate in a social web of power. What this means is that a new proposal for mathematical access and opportunity will govern, regulate, and discipline students as well as teachers. In other words, the identities that students construct of themselves will be made in and through the proposal’s pronouncements, its interests, and its investments in others. Power will do its work through the material, discursive, pedagogic and technological forms, as well as through the proposal’s discourses that relate to categories of gender, ethnicity, and a range of other social determinations. In short, a vision of change that is conceived of as emancipatory will always, at the same time, be regulatory.

We are beginning to get a sense of the political nature of educational development. To put politics into the immediate context, let’s consider the proposal that the school will enrol 100 Grade 8 learners in its first year of operation, and thereafter growing each year by 100 learners at the same level until a total of 500 learners from Grades 8-12 are enrolled. The fundamental Foucauldian knowledge/power postulate maintains that these students will be produced as subjects under the specific discursive conditions made available to them by the terms of the proposal.

It follows, then, that interventions like the one proposed, will produce new subjects and practices and will regulate both. Interventions are part of a wider range of technologies that are involved in the production of the modern subject. As a regulatory apparatus, they impose certain meanings, subjecting individual students and teachers into particular understandings of themselves as students and teachers. In that sense, the potential dangers of all discourse, including a proposal whose stated objective is to
liberate, come to the fore. The utopianism of interventionary action must be considered in light of its constraining and inhibiting practices. The Foucauldian question to consider concerns how we might address the point that there is no emancipatory space ‘outside’ normalising discourses.

THE PSYCHOANALYTIC QUESTION

There is another issue, too, that deserves attention. The students who never enter into the process of being produced as a subject within the discursive conditions of the intervention are, in a sense, ‘de-produced’. That is not to suggest in any way that they are not constituted within that production. It means, rather, that their exclusion from the horizon of recognisable subject is fundamental to the very production of the recognisable subject. The fact is that some students will be produced as learners within your discursive construction of a secondary school student at this school, and others will not.

We need to think through the price, not in economic but psychic terms, that needs to be paid for the inclusion of some students and not others. This is your question of learner selection: Whom do we select, how and why? The question can be framed as a psychoanalytic one, relating to subjectivity: “At what price does one become a mathematics student in this school?” This is an important question but it tends to be ignored by the mainstream discourse on educational development. For those who are included, the price will depend on the selection criteria and its presumptions, and what needs to be surrendered to satisfy the criteria. The obliteration might involve generational and parental knowledge. It could involve ethnicity. It could be friendships with ‘de-produced’ students, and so forth. For those who are excluded, the price will accompany the realisation of being ruled-out of education in this school, and will likely be lived out through forms of suffering that tend to go hand-in-hand with practices of exclusion.

THE CULTURAL QUESTION

What might be included in the mathematics curriculum? There has been much transportation of educational theories about curriculum developed within major nation states, just as there has been a practice of exporting ideas about educational reform, child development, teaching, learning, and assessment. We might think of the practice as situated within a developmental paradigm of one-way border crossing, in which ideas, practices, expertise and materials promoted by aid and development programmes, UNESCO, and so on, are considered universally true for every school system, every community and every student cohort. In New Zealand it took us a long time to appreciate that educational ideas, tests, and textbooks, imported from other parts of the world, were not necessarily generalisable for our specific context.

A curriculum transported globally overlooks important local knowledge about language, culture, family systems and values, citizenship and community. In other parts of the world, a number of researchers (e.g., Civil, 2002; D’Ambrosio, 1985) have
privileged local knowledge and attempted to design their curricula around it. They have engaged with the local culture, its history, its demographics, and identified points of difference within that culture, not at a superficial level, but at the level that generates understanding of the day to day practices, the belief systems, and the power struggles. Engagement with these realities is a crucial starting point. The engagement will likely not only unravel details of life ‘lived at the edges’ but also important modes of operating within the social order. As one instance, you note that transport is expensive. Rather than centralising the teaching and learning opportunities in one site, you may choose to create village campuses—hubs of teaching and learning, not reliant on technology, in a number of localities.

Critical scrutiny might reveal that pedagogy is teacher-centred, that students have a high respect for their teachers, and that basic skills are lacking. A low-definition curriculum might be called for. An analysis of current classroom and everyday life might suggest a need to go against the grain of mainstream theories of teaching and learning. A rigorous assessment will pave the way for informed curriculum policy decisions—decisions that are not simply based on inherited ideas from other cultures in order to play the game of developmental ‘catch-up’. A curriculum developed with careful thought will give expression to the key point that curriculum policy development sits at the nexus of culture, history and place.

CONCLUSION

Some years ago, in relation to the debate centred on progressive education, Valerie Walkerdine (1992) asked: “An idealist dream, an impossible fiction, or something to hope and struggle for?” Posing that same question for the proposed new school in a deprived setting within South Africa, my answer returns to the point made in the first paragraph: The proposal is both an instructive response and an emancipatory gesture to one of the most complex and pressing issues facing mathematics education in South Africa today. While it is indeed ambitious, its realisation is truly something we would want to hope and struggle for. But to make the dream a reality we need to move away from understanding the project as one which perceives the Other as the problem, and the ‘liberator’ as the solution to that problem.

My advisory notes have outlined the fundamental points for the calculus of the proposed social change. But there is one further point to be made: an ethical response to emancipatory efforts recognises that people have different histories and different ‘presents’ and attempts to preserve the difference of the Other. An ethical approach turns upon itself to examine the emancipatory discourse itself, constantly interrogating its pronouncements and the new norms of social and educational relations it engenders. In leveraging the potential of the Other, what eventuates is a “truly educational experience…connected to past and future educational experiences and to other on-going life experiences” (Noddings, 2012, p. 776). Mathematics at the edge within one setting in South Africa might then be reformulated as mathematics at the cutting edge. Mathematics not above, not below, but beside.
References


