

A contextualised approach towards making connections between mathematics and other school curriculum disciplines

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Abstract

There are widespread calls for mathematics to be taught in ways that it is seen to be meaningful to learners and links with their everyday realities. In South Africa, the new curriculum urges teachers to make explicit links between mathematics and other school curriculum areas. However, approaches to put these aspirations into practice are not clear, particularly in the context of realities of schooling in typical township classrooms. This paper reports on an exploration involving the use of a school tuckshop and vegetable garden as contexts for learning mathematics and making connections between mathematics and other learning areas. Teachers' perceptions about the extent to which this may be a viable approach are investigated. It is noted that while teachers see constraints in this approach, the researcher's experiences with the school context and conditions of schooling in South Africa point to immense possibilities that this approach presents for making meaningful connections within and across school curriculum disciplines.

There have been several attempts in South Africa and internationally to connect school mathematics and other learning areas (Adler, Pournara & Graven, 2000; Huntley, 1999; NCTM, 1989). According to the South African National Curriculum Statement for Mathematics,

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the National Qualifications Framework. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting integration and applied competence, the National Curriculum Statement Grades 10 – 12 (General) seeks to promote an integrated learning of theory, practice and reflection (Department of Education (DoE) 2003, p.3).

The DoE recognizes integration within mathematics by acknowledging that “Learners need to be able to see the interrelatedness of the Mathematics they are learning” (DoE, 2006, p. 49). It is also observed that “integration within a learning area is automatic in the sense that you cannot work with measurement without integrating with number” (p. 76). This means that integration within learning areas is an inevitable activity. Adler, Pournara and Graven (2000) have identified various levels of integration: “integration of the various components of mathematics, between mathematics and everyday real world knowledge; and where appropriate, across learning areas” (p. 3). They have argued that while integration is desirable, the extent of the demands placed upon teaching makes integration less feasible.

The complexity of translating curriculum expectations into practice is particularly important in relation to the requirement that teaching needs to integrate across learning areas. It needs to be acknowledged that working in integrated ways in the school curriculum makes available new visions and realities for schooling. However, bringing about this vision into reality is a complex activity that is likely to meet with challenges both within and beyond specific curriculum disciplines (Presmeg, 2006).

This paper reports on progress with implementation of an innovative idea involving a school “tuckshop” and “vegetable garden” framed in the context of a broader international research project¹ that has the following central question: *How can curriculum change in mathematics and science education be implemented in a way that is most relevant for Africa, particularly focusing on situations of poverty and on promoting gender equity?* The international project has three interlinked aims:

- To investigate current teaching practices in a sample of mathematics and science classrooms in the broader context of curriculum change in South Africa, with particular emphasis on poor communities. On the basis of this investigation, the aim is to work with teachers to conceptualise and initiate appropriate interventions.

¹ The Education Policy Unit and Marang Centre at Wits University are involved in an International project *Implementing Curriculum Change in Low-Income Countries* funded by DfID UK, with partners from higher education institutions in Rwanda and Pakistan.

- To design and carry out a participatory action research program informed by the needs of teachers and involving their school communities.
- To gather information to understand and assess progress towards quality education in mathematics and science in situations of poverty and disadvantage.

The implementation of the broader research project in South Africa involves an exploratory case study (with a collaborative action research approach (Kemmis & McTaggart, 2005). The project is being carried out in which a group of teachers and their learners in a joint partnership with mathematics education researchers are investigating what happens to students' learning when their school (mathematical) work is linked to activities and processes in their school tuckshop and vegetable garden. In our regard for collaborative action research we intend to be alert not only to the very ironies and contradictions that lie within community regards for reforms and initiatives, but also the possibilities for creating opportunities to negotiate tensions and build ownership of initiatives. In a similar study Keane explored the possibility of implementing a relevant curriculum through collaborative action research (2006). In the process, she deep-seated beliefs and tensions that limited the success of a collaborative project. For example, although the community and students expressed frustrations about the irrelevance of the science curriculum imported from Western ideals of science, they were also suspicious that attempts to change the science curriculum would deprive them of access to high status knowledge. Therefore, the approach underpinning this collaborative project would involve negotiating tensions and complexities that often arise out of rendering school curriculum relevant.

Why the tuckshop and vegetable-garden idea? It is a common experience for schools to have tuckshops and vegetable gardens as part of their school formal structures. In the school in which the study is being implemented in a low-income township of South Africa, we have observed that a tuckshop exists, but it is not functional. We have also observed that people (mostly unemployed women and the youth) from the community around the school bring food items to sell to learners at the school during "tea" and lunch-hour breaks. We can see here that there is a crucial link between this school and its community that can be utilized for learning about mathematics and science, and other school curriculum areas. In this research we are attempting, in an exploratory way, to formalize (collaboratively with teachers and learners) this important and survival-oriented link between the school and its community by reviving the tuckshop that already exists in the school. We intend to document the processes that will be involved in the setting up of this tuckshop, in particular, the thinking and decision-making processes that take place among grade 10 learners and their teachers in the school. We anticipate that a lot of this thinking and decision-making will involve the use of mathematics (and other learning areas). Together with the teachers we intend to bring that mathematics to the fore, to understand the nature of this mathematics and forms of mathematical knowledge (its relevance and power), and to find ways of using that mathematics as an entry point for making grade 10 mathematics learning linked to everyday reality. We also intend to explore the kinds of mathematics that can be learnt from investigating connections between the formal school curriculum and the vegetable garden, which, in contrast to the tuckshop, is fairly functional and is being managed by the community outside the school.

The fact that the tuckshop is not functional presents a real problem and concern for the school and their learners. Understanding this problem and investigating possible ways of making it more functional will be important for the school, particularly in the context of some of the important opportunities that this problem presents for learning about mathematics, science and other community knowledge. South Africa is now implementing a new curriculum (Department of Education, 2007) which makes it imperative that learning mathematics needs to be linked to the reality of learners. Learners are required to develop "a critical awareness of how mathematical relationships are used" in various contexts. There are explicit demands for mathematics education to make visible in learners "an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation" (Department of Education, 2002, p. 1). However, we need to know more about what it means to implement ideas such as these in typical classrooms in township schools. This project aims to engage with these ideas at the school and classroom levels in such a way that it addresses the demands of the new curriculum and links mathematics teaching and learning to school realities and community-related influences and needs for mathematics education.

In the rest of this paper, we report our first experiences in beginning this exploration by presenting in a narrative manner our conversation with one teacher (also deputy head of the school) on his perspective on the ideas of the school tuckshop (see Figure 1) and vegetable garden². In presenting this discussion, we reveal the initial opportunities and challenges that the tuckshop and garden ideas present for linking the school curriculum disciplines and everyday reality of learners. Finally, we link our exploratory experiences and the discussion with some literature on school tuckshops and school gardens and suggest that in order for schools to implement educational reforms of the nature being currently proposed in South Africa and elsewhere, they need to be engaged in learning and development activities that harness everyday and community-related structures and initiatives.

Understanding the tuckshop context

At the beginning of our research investigation, we had a conversation with one teacher in order to understand the status of the school tuckshop and vegetable garden. In the description that follows, we report on our conversations with the teacher. At the beginning of the conversation, the teacher said:

I appreciate the issue of the tuckshop because as a school we don't have a tuckshop because of the service that we render. We are serving the most disadvantaged learners. We have seen that the tuckshop would not make much money. Unlike those people who are in the suburbs, the tuckshops there are able to benefit the schools unlike us. But once you are with us here, that would give us an idea of how to make the tuckshop benefit the school profitable for the school

We note here that the school does not have a (functional) tuckshop. The reason for the disfunctionality is related to the kind of learners that the school serves: "disadvantaged learners". Within this context of disadvantage, the teacher feels that the school cannot make as much money as other schools in suburbs that attract more advantaged learners. We see here that "disadvantage" is seen and experienced as a real constraint to the profitability of an innovation of a tuckshop.

No we do not have a tuckshop presently. We have a room but we don't use it to the benefit of the school because of the you see we've got a lot of unemployment around us. So there are lots of those aunties³ who come around to sell to the children so that they are able to pay for them when they have to go to school. They sell so that they can also be able to put food on the table for their children and then able to pay for their for them when they go to school. That makes our tuckshop to be ineffective.

We also see from the above that the fact that the school is not able to make use of the tuckshop for its benefit presents an opportunity for community members ("aunties") to set up selling points at the school. We see that the selling activities of these "aunties" benefit the children who attend the school. Although the tuckshop is ineffective from the perspective of the school, this context presents an employment opportunity for these aunties. A question that needs to be answered here is: what are the real causes of the tuckshop being "ineffective"? The teacher invited us to "to spend time [at the school]" in order to "see the dynamics" there. We were welcomed to "come see for [ourselves] and talk to those children', who, in his understanding, "cannot afford to buy a cool drink".

The teacher mentioned that the tuckshop had been working before and was being run by a former student to the school:

One of our former students rented out that space of the tuckshop and his son was supposed to pay 150 Rands a month. But you see you up to now when he is supposed to pay he struggles that month. He sometimes pays

² The context of the vegetable garden is described more fully in Mwakapenda (in progress): "The mathematics and science of a school vegetable garden". Briefly, the school has a beautiful vegetable garden (see Figure 2). It is project run by people around the school, the community of unemployed people. The school considered it inappropriate to keep "having a plot of land that is not used profitably". The school recognized that it served the community that is unemployed and poverty stricken but have children who attend at the school. It then recognized that they [people in the community] need food and have to pay for their children. So the vegetables they get they sell to the school community and the community around and put food on the table. The teacher indicated that this arose from an agreement about networking with former students. The vegetable garden has been running for more than five years now.

³ Women from the community

only 100 which we [the school] are charging for the electricity that he uses. But he is struggling to pay that hundred and fifty Rands a month that means that he is not making enough.

The above extract presents further evidence of the ineffectiveness of the tuckshop. It also emerged in our conversation that the person renting the shop “works on his own. The school has no hand at all in that [tuckshop]”.

The teacher was asked to comment on whether there were tuckshops outside the school and whether they were profitable.

We have tuckshops around the school. They are making money. It is not only food that they are selling. They are selling cigarettes, beer. Things that we cannot sell as a school you see that. They sell everything, mealie meal, things that we cannot sell as a school. We want to sell stuff that they can consume there and then. ... there are other articles consumables that we cannot keep in the school, things like cigars we cant sell them in school... They sell everything. We can sell some of the things that they sell. So if we can let them come to our tuckshop they can find some of the things they need.

There are clear differences between tuckshops from the community around the school and the school tuckshop in the kinds of items that are being sold. The fact that the school can only sell items of a nature that would be more “acceptable” in the school makes it difficult for the school tuckshop to remain profitable and competitive. The manner in which the items are presented for sale in outside school community tuckshops also seems to render the school tuckshop sales unprofitable. “You see the snacks the simba chips that they buy are in small packets which are broken down from large packets of chips”. Again, the teacher invited us to visit the school so that we see “the dynamics” of the school.

You will see what students consume. You’ll see that as an institution we won’t be able to make any profits in whatever they sell. You’ll see that once we start operating that tuckshop as a school those aunties that sell to them also they are going to be cut down. They are going to close their stores and these are the aunties that help to sustain the same school and pay for children for their school and are able to put food on the table for their children. So it is going to disadvantage us as a school to open a tuckshop.

We see from the above that reviving the school tuckshop would constrain the income-generating activities of the aunties whose children the school is meant to be serving. However, it is in the common interest of both the school community and the ‘aunties’ that the ‘tuckshops’ selling cigarettes and beer do not succeed in penetrating the students. Therefore, there is a benefit in exploring ways in which both the school and the aunties can make the school tuckshop more viable and thus wade off the threat posed by these tuckshops to the good social and health habits of students and teachers. One of the critical stages of negotiating a collaborative project such as this one is to bring to the fore both the tensions and the possibilities presented by the context. Often participants who are embedded in a context more readily see constraints than possibilities. In an earlier paper concerning this project, teachers highlighted such constraints as large class sizes and the pressures of covering the syllabus (Nyabanyaba, 2006). The possibilities of collaborative research is that researchers and educators may use a community of practice to explore and support each other in implementing innovative ways of teaching in such constraints without necessarily making the real constraints disappear. In this case, the income generating activities of the aunties thrive on the fact that the school’s tuckshop is not functional. However, it would seem that instead of this being seen solely as a constraint, one would expect that this conflict of service presents an opportunity for collaborative activity between the school and the aunties in so far as tuckshop related activities are concerned. In response to the question: “Do you expect some kind of a working relationship between the aunties and the school? Do you see that happening?” the teacher said the following:

The question is you see these aunties whatever they sell they would want to see they would want to get the profits today rather than end of the month. I don’t think they can sustain their business if they don’t get their profits today. But they are part of the school and we can’t do away with them.

The above remarks indicate that the aunties seem to have an immediate profit-making goal in their selling business. The school might however have a longer-term or even different goal in their operation⁴. It would appear that this conflict of needs and goals would make the school-community partnership

⁴ There is much research evidence that demonstrates that the goals of activity in school and those of outside school activity have different intentions (Lave, 1991).

impractical. However, without a project that connects the curriculum and reality as this one seeks to, no one has put up both the curriculum and practices of the communities up for scrutiny. The possibilities are there now to begin to evaluate the extent to which the school curriculum can be brought to bear on real issues. This is not to say that the process will be tidy and all the tensions will disappear. For example, the kind of items that the school would want to sell would also make the school tuckshop ineffective.

If we are going to have an effective tuckshop, by effective we mean a tuckshop that will be able to sell things like biscuits and cool drinks. But those are not basic things for our learners. They won't afford such things. They'll be failing to buy them because they can't afford. The cans of cool drinks will stay longer because they cannot afford them. That will be the problem.

The foregoing comments point to a key issue that would determine the effectiveness of the tuckshop. On one hand, it might be worth considering items that could be placed in the school tuckshop which would only be afforded by learners. However, it might turn out that those items cannot be afforded by people in the community, and some learners. On the other hand, the above discussion points to a need to ask the questions: What do learners really need? What are learners' needs with respect to the tuckshop? Answers to this important questions would help in articulating profitable plans for the school tuckshop. In the broader frame, the above discussion points to the need to consider the kinds of links that need to be forged between the school tuckshop and the activities of the school curriculum. There is also a need to understand the extent to which people from outside the community could inform and shape school activities, in the context of this particular school. In the wider context of South African education, there is a government policy that provides spaces for schools to work with the community. According to the teacher, "Tirisano" is a policy from the government which requires that "schools and local communities have to work together". There is also a policy known as "Vukuzenzele", which, according to the teacher calls upon learners and others to not "have to expect everything from the government". It emphasizes "What you can do for the country and not what the country can do for you". Within this policy framework, schools and learners are allowed to "take initiative" and "be proactive". It is against this background that the teacher felt reviving the idea of the school tuckshop was desirable in spite of the practical challenges in its implementation.

Tuckshops and vegetable gardens in the field of mathematics and science education

The concept of tuckshops and vegetable gardens occupies an important space in the field of mathematics and science education broadly (Drummond & Sheppard, 2004; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Moe, Roberts, & Moore, 2001). In the context of South African education, the issue of tuckshop and vegetable gardens in schools is rarely explored in spite of the fact that tuckshops (and spaza shops) form a significant aspect of the informal trade sector of the South African economy (Ligthelm, 2005). This lack of attention points to a possible lack of understanding and acknowledgement of the possible roles that tuckshops and gardens could play as "learning laboratories", as informal sites for learning about mathematics and science and other areas of the new school curriculum. The literature demonstrates a very important role that tuckshops play in academic instruction. In a survey on the use of gardens in the academic curriculum in USA schools, Graham et al. (2005, p. 149) have reported that:

School gardens appear to be predominantly used by most schools to enhance academic instruction through teaching subjects such as science, environmental studies, nutrition, language arts, and math. This indicates that the garden is being used to teach some of the core academic subjects, possibly with the incorporation of core curriculum standards.

According to Drummond and Sheppard (2004), "school canteens are an important part of the school environment" (p. 13) including those of schools in "underprivileged areas" (Moore, Paisley, & Dennehy, 2000). It has also been recommended that "in addition to school meals, health eating could be encouraged in schools via healthy tuckshops" (Moe, Roberts, & Moore, 2001). There is therefore an important role that schools need to play in promoting healthy diets for school-going children. While children in some schools may benefit from feeding schemes, other children, particularly at upper levels of schooling in public and less advantaged schools are expected to bring snacks and lunches to schools. There are calls to understand the nutritional composition of the items children bring to schools.

The conversation with the teacher demonstrates that while there are challenges in setting up and managing school tuckshops, there are opportunities that the tuckshops present for understanding school

environments, learners' conditions for learning, and, in particular, the broader context of schools that involves connections with communities. Commentators in education reform have argued that if school reforms have to be successful, they need to be linked to efforts that are intended to the strengthening of communities around schools.

What sense does it make to try to reform urban schools while the communities around them stagnate or collapse? Conversely, can community-building and development efforts succeed in revitalizing inner-city neighborhoods if the public schools within them continue to fail students? The fates of urban schools and communities are linked, yet school reformers and community-builders typically act as if they are not (Warren, 2005, p. 133).

Warren (2005) has pointed out that educators and community developers have frequently operated in isolation both professionally and institutionally. He argues that it is difficult to “teach children well if teachers lack an understanding of their students’ cultures and lives” (p. 134).



Figure 1: School tuckshop



Figure 2: School vegetable garden

Discussion

Bringing schools and communities in collaboration enhances the social capital and relational power⁵ that both schools as institutions need in order to be transformed. We conceive school tuckshops and vegetable gardens as playing a useful role in bringing the school curriculum closer to the everyday community context in which it is to be implemented. More specifically, we see school tuckshops and gardens as presenting a more lived experience upon which to inform, though not unproblematically, attempts to make mathematics and other learning areas meaningful and relevant to school-going children. It is evident that the process will not be tidy. It is not easy for teachers in contexts of difficult delivery to see beyond constraints. However, the negotiations that guided the coming to be of the projects provided researchers

⁵ According to Warren (2005), social capital refers to “the set of resources that inhere in relationships of trust and cooperation between and among people” (p. 136), while relational power refers to “power to’ get things done collectively” (p. 138).

with insights into the concerns and priorities that shape teachers' practices. While the task of making teachers see beyond constraints to the benefits of linking such a notoriously inaccessible subject as mathematics with real concerns will not be an easy one. However, there are real benefits including the opportunity to explore ways in which the aunties' survival-oriented activity can be rendered more efficient and possibly more sustainable through the use of mathematics. Therefore, in linking mathematics and everyday 'reality', mathematics educators and researchers have the possibility of transforming both the curriculum and the lives of communities around. It is a way of bringing the curriculum to life and bringing the lives to the curriculum.

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