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From contextual frustrations to classroom transformations: female empowerment through science education in rural South Africa

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ABSTRACT

The objective of this transformative action research project was to explore and develop sustainable methods to promote female empowerment through science education in rural, disadvantaged sectors of South Africa. In an attempt to achieve this we collaborated with local community members to develop and implement a contextualized science curriculum at a school in the aforementioned setting. As soon as the project was launched it became increasingly clear that although the ideology of ‘empowerment through science education’ seemed a promising venture, it could also be an extremely complex and often frustrating undertaking. This was especially true when working within an unfamiliar cultural setting. Numerous challenges, such as the lack of teacher motivation, malnutrition amongst the learners, and conflicts stemming from differences between the indigenous knowledge and the western concept of science, greatly impeded the delivery of quality education in the area. These challenges had to be addressed both in pedagogical and practical terms before any attempt towards liberatory education could be made. This article sheds light on the complex inter-relationship between the human factor and the organizational and physical infrastructure at a school. It begins with a brief description of the local context and goes on to identify the theoretical underpinnings and chosen methodology for the project. The article concludes with a review of the complexities involved in possible attempts to initiate and foster educational and social transformations in a rural South African setting. We contend that it is essential to first be thoroughly familiar with the background, culture, and needs of any community before any attempts are made towards social justice.

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Introduction

Since the early 2000s, science educators have been lamenting the fact that education has been disassociated from the contextual realities of life and living. Kyle asserts that ‘education must be transformed from the passive, technical, and apolitical orientation that is reflective of most students’ school-based experiences to an active, critical, and politicized life-long

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endeavor that transcends the boundaries of classrooms and schools' (2006, 16). But what if the context denies learners the opportunity to access quality education? This was the lived experience of learners in the rural school and community at the outset of this project. A variety of economic, social, and cultural factors were inhibiting learners from reaching their potential. Herein we describe a collaboration with a community in which we generate (co-construct) and foster sustainable contextual and infrastructural transformations. The intention was to attend to impediments outside the classroom in order to create conditions for meaningful education within the classroom. The project began in 2012 and continues to this day.

In transformative action research, researchers spend time within the community to construct an understanding of the local context, customs, and traditions. During this period, social relationships develop in which the researchers often transition from being viewed as outsiders to becoming insiders with a shared moral determination to collaborate, take action, and transform the community. This type of research was successfully done by Ahmad, Gjøtterud, and Krogh (2016) in Tanzania, where they conducted a three-year participatory action research project that focused on developing pedagogical interactive teaching strategies for relevant learning in Tanzanian rural contexts. Our study, however, emphasizes gender and girls as informants.

In this article, we highlight the complex inter-relationships between the human and organizational and physical infrastructure in the collaborating school. We offer a brief description of the local context, then furnish the theoretical underpinnings and methodology of the study, and conclude with an account of the pedagogical complexities and transformations that transpired. Science education, in particular contexts, can be oppressive and pose challenges for learners to overcome. Ultimately, the community at large was engaged in the identification of issues of concern, analysis of the situations, understanding of the situations, and action-taking. Over time, the emergent solutions arising from the project evidenced a broader sense of empowerment within the community.

Background

Opportunities have been created in South Africa for the previously disadvantaged in a pursuit to eliminate racism, sexism, and religious oppression in the corridors of power. However, tremendous challenges persist, such as high poverty, inequality, and a dualistic economic and social infrastructure (Donohue and Bornman 2014). Discrimination against girls and women – based on age, social status, education, and health – is still a reality, especially in rural areas (Stark and Ager 2011). In South Africa, women and girls in rural areas are among the most disadvantaged of groups.

However, urbanites are often isolated from the imbalances, disparities, and poverty associated with life in rural areas. We thus engaged in a transformative action research project oriented towards promoting female empowerment through science education in a sustainable manner in a disadvantaged rural area. We collaborated with local community members to develop and implement a relevant, contextualized science curriculum. As researchers, our respective points of departure for engaging in this project differed considerably; however, we shared a common belief in the potential of science education for the advancement of gender equity.

While ‘female empowerment through science education’ sounds like a laudable goal, there were community-based challenges to actualizing the goal that needed to be understood and addressed. The lack of teacher motivation, the high incidence of malnutrition amongst the learners, tensions between indigenous conceptions, traditions, and aspirations, and the western perspective of science all offered significant challenges to the delivery of education. It was necessary to address such issues prior to developing an empowering education oriented towards females.

The goal of the project was to explore ways in which the science curriculum could be contextualized to enhance educational opportunities for female learners in a rural, disadvantaged community in South Africa.

The four main objectives were as follows:

- To conduct a thorough situational analysis of the local context.
- To determine the criteria for a relevant, contextualized curriculum.
- To design and implement a contextualized curriculum unit.
- To determine whether the interventions contributed to social justice within the rural community.

The community

The collaborating community is situated in a rural area characterized by widespread poverty, high levels of unemployment, and a limited financial base near the township of Hammanskraal in the North West Province of South Africa. The standard of living and race are often closely coupled with extreme poverty, mostly concentrated among black South Africans (Leibbrandt and Levinsohn 2011). The community has limited access to resources, such as health care, libraries, financial services, grocery stores, shopping centers, and community centers for youth. The community has a high incidence of crime, drug addiction, alcoholism, and an HIV/AIDS infection rate above the national average.

Most learners do not graduate from secondary school. This is especially true for girls, who are often expected to leave school after primary education for gainful employment or simply to stay and tend the homestead. Girls are responsible for collecting water, cleaning the house, doing the washing, grinding the corn, tending to the fields, and preparing the meals. Under these conditions, and in relation to boys their same age, there is limited time available for girls to do homework or to participate in extra-curricular educational activities (Branson, Hofmeyr, and Lam 2014).

Context of the school

A rural school was chosen from the first quintile (underprivileged, funded by the government). Under the South African Schools Act of 1996, education is compulsory for all South Africans from age seven (Grade 1) to age 15 or the completion of Grade 9. In most state schools the government provides the minimum financial resources and the parents contribute to basics and extras in the form of school fees.

In this community collaboration, many learners were from child-headed households. According to the principal, in most cases both parents are deceased, in many instances as a result of HIV/AIDS. However, in other cases one of the parents might still be alive but may

be working in a distant metropolitan area and is only able to reside in the household a few days each month. The rising mortality rate has serious consequences for the learners. While feeding programs exist in many schools in South Africa, at the onset of this project there was no food program at the collaborating school.

Theoretical underpinnings

To frame the central research question, we drew from literature on social justice, liberatory education, female empowerment, and context-based education.

Social justice

To determine the level of social justice in the community, we utilized Martha Nussbaum's (2002) capability approach. She argues for an ethical foundation of measuring the individual's empowerment through 10 basic human capabilities. This approach to human well-being emphasizes the importance of freedom of choice, individual heterogeneity, and the multi-dimensional nature of welfare.

It is furthermore essential to determine what the women or group in question are actually able to do and be, before any attempt to promote empowerment can be made. Thus, it was necessary to gather sufficient information on the level of female empowerment in the local community. The objective was to aid the conceptualizing of a science curriculum that could contribute to social justice in a rural, disadvantaged community in South Africa.

Liberatory pedagogy

Paulo Freire's ([1970] 1993) liberating pedagogy offered valuable insight for this project. He argues that any curriculum which ignores racism, sexism, the exploitation of workers, and other forms of oppression supports the status quo. It inhibits the expansion of consciousness and blocks creative and liberating social action for change. Paulo Freire ([1970] 1993) asserts that if current circumstances are oppressive, as was the case in the collaborating community, it is the clear duty of the educator to educate for freedom and for the creation of a new social, political, and economic order. Meaningful education should enable the oppressed to regain their sense of humanity. In addition, Freire stresses that it is important to encourage learners to think critically about their own educational circumstances. Such an approach enables learners to identify connections between their individual experiences and the social contexts. In essence, oppressed individuals must play a role in their liberation. Ahmad, Gjøtterud, and Krogh (2016) agree this emancipatory aspect is crucial to develop knowledge that is locally relevant and to achieve an awareness level whereby participants recognize that when they create knowledge their confidence may increase.

Female empowerment

Herein, 'female empowerment' was based on the theory that gender is a social construct and gender relations are constructed and reconstructed as a result of the behavior of society depending on the developmental changes in the community (Christens 2012). Women's subordination has no single cause or single solution. Hence, there is a rejection of universal,

simplified definitions of social and natural phenomena and a call for the recognition and celebration of differences (Sen and Grown 2013). From this theoretical perspective, any attempt to promote female empowerment has to encourage individualism in the community and ‘phenomenological, personal accounts of multiplicity and contradiction’ (Gore 1993, 49) has to be fostered. For girls to be active agents of transformation, the intervention (in the form of the contextualized science curriculum) ought to inspire and encourage them to take an interest in their own education.

In as much as the project contemplated empowerment, both as the means and the outcome of the liberatory contextual science curriculum, it was equally as important that learners should be guided to think critically about their own education. Such an approach enables learners to identify connections between their individual experiences and the social contexts in which they are embedded (Freire [1970] 1993).

Context-based education

Aikenhead and Michell (2011) affirm that for science education to be meaningful in any context it must incorporate the unique culture and indigenous knowledge of the local community. Yet through this project we have learnt this is not always the case. The barriers thwarting girls in their pursuit of universal primary education, or the expansion of opportunities for secondary education, were numerous. Cultural barriers within society ‘may block the role of women, for example, leaving half the population without economic or political rights and without education, thereby undermining half of the population in its contribution to overall development’ (Sachs 2005, 60). Sachs documents how denying women their rights and education results in cascading problems. In addition, formal curricula are mostly geared towards academic accomplishment and formal-sector employment in urban centers, rather than focusing, when appropriate, on the empowerment of girls within their rural milieu (van Romburgh and van der Merwe 2015).

Science is often seen as a body of knowledge to be understood and mastered, rather than knowledge that has the potential to interact with and respond to the lives of the learners in the context in which they live (Gray, Colucci-Gray, and Camino 2009). Currently, science education in South Africa is more concerned with transferring canonical knowledge than with facilitating students’ conceptualization and understanding of relevant scientific knowledge for the purpose of community development and social transformation. Science education is thus perceived as irrelevant within local communities, because it presently does not contribute to the knowledge necessary to transform and improve the local situation and address issues of sustainable development (Kyle 1999; Onwu and Kyle 2011).

Action plan

Orientation to research

Our commitment to human rights, social justice, and democracy – in conjunction with numerous calls for female empowerment in developing countries – rendered transformative action research as an appropriate research orientation. Such an orientation to research takes the central tenets of action research and builds upon the principles of participatory engagement (Chevalier and Buckles 2013). Brydon-Miller and Maguire (2009) emphasize that this

framework of research makes an effort to meaningfully include more students, their families, and communities in the research process. The strength of this research methodology is that learning and research are done together. Such an orientation to research brings together 'community members and researchers, who are committed to participation, action, reflexive inquiry, achievement and dialectic critique for the purpose of social transformation' (Malcolm et al. 2009, 194). It enables a community to express its own needs, create the research agenda, conduct public deliberations, and take action. This approach to research goes beyond the action research concepts proposed by Kurt Lewin (1946), and refined by Stephen Kemmis and Robin McTaggart (1988a, 1988b) and Ortrun Zuber-Skerritt (1992), which are often framed within an ahistorical, apolitical value system, with methods codified into moments of planning, acting, observing, and reflecting (Malcolm et al. 2009). Rather than concentrating on reflection, in a technical domain, we focused on the moral obligation to become involved, take action, and transform.

It was therefore necessary to gather sufficient information on the reality of life in the community. The objective was to gain a thorough understanding of the situation and status of girls and women in the area in order to assist in the conceptualizing of a contextualized curriculum that could ultimately contribute to social justice in the area.

Data collection

Prior to the start of the collaboration, we obtained background information regarding the community from the local provincial offices. We progressively expanded our knowledge of the community and deepened our understanding of the context by gathering information through semi-structured interviews, direct observations, and sharing our interpretations of the information as it was collected. The following steps guided the data collection process:

- Consent was obtained from each participant.
- Participants were identified by purposeful sampling strategies.
- Interviews and discussions took place in a suitable venue, such as under a tree or inside a house, wherever the participant felt most comfortable.

Most of the conversations were audio-recorded, brief field notes were taken, and probing questions were used. All data collection transpired in a spirit of being courteous and respectful at all times (e.g. local greetings were used, there was adherence to cultural norms, permission was always asked prior to taking photographs, and local culture and traditions framed the discourse).

Gaining access

It was crucial to spend quality time in the community to ensure the project would be sustainable in the long run. After an initial visit to the school, the school principal introduced the researchers to a member of the community who served as a gatekeeper and introduced us to other important members of the community. He explained our intention to conduct research in the area to the rest of the community, and described the purpose and methods of the intended project. He also familiarized us with the local greetings, customs (including appropriate clothing), structures, and hierarchies in the community.

The following groups participated in the project: teachers, parents, community leaders, traditional healers, elders, local nurses, and social workers, as well as the Grade 9 learners in the senior phase of the General Education and Training Phase (Grades 7–9). This phase was chosen because it is the last phase in the compulsory education system and the drop-out rate among South African high school learners is more pronounced after Grade 9.

Observations

The majority of data-gathering techniques focused on specific contextual information. Anne Marshall and Suzanne Batten (2004) assert that the success of an action research partnership rests on three crucial fundamentals: the presence, influence, and insight of one or more socially committed researchers; the active involvement of community members; and a matter of critical interest to the group of individuals in question. The first step was to collect descriptive data on the community, such as demographics (e.g. basis of local economy, population changes, poverty rates, and local resources), from the local provincial offices. It was also important to spend time in person in the community and to become familiar with the local assets and complexities in relation to meaningful science education in the area.

We will never forget the rainy day that we first arrived at the rural school. It is an experience that had a profound impact on us. We introduced ourselves to the headmaster and explained the purpose of the project. He seemed quite positive and proudly offered to show us the school grounds. The school was in a dilapidated state. Buildings were only half finished and most classrooms were overcrowded with more than 80 learners. The school lacked basic school materials. The only teaching aids were a chalkboard and some outdated posters on the walls. Learners did not have textbooks or any other form of teaching aids. Water was leaking into the classrooms through the holes in the ceiling and the ablution block was very disagreeable. The lack of resources and basic infrastructure (e.g. sanitation, clean water, and electricity) was not conducive to learning. Classes were comprised of mostly boys, with the girls having dropped out in many cases due to lack of money because it was deemed more of a necessity to educate boys than girls.

To relate the observations to the purpose of the project, we focused on the cultural practices that may have an influence on social justice in the area, such as: the cultural practices in the community; the traditional role of women, girls, men, and boys in the community; whether women/girls are in traditional leader positions in the community; whether women/girls are involved in the community; and the traditional beliefs in the community. In essence, information was obtained about the general lifestyle in the community. With little exposure to the norms, interests, and local culture before we entered the community, we were able to observe each of the participants as proxies for the bodies of local knowledge and witness their discursive actions. To determine the level of female empowerment and social justice in the collaborating community, observations focused on the basic capabilities as described by of girls in the area (Nussbaum 2001).

Interviews

Once the learners and other members of the community were accustomed to having an outsider around, the gatekeeper introduced the field researcher to other important stakeholders within the community. The field researcher commenced by listening to the oral histories told by elderly men and women about themselves, their community, and its history. This provided ample opportunities to listen, observe, experience, and become part of the

pace of life in the community. The conversations were then interpreted and transcribed. The interpretations were checked with the community members to ensure accuracy through oral discussions (McNiff 2016). The field researcher conducted numerous unstructured group, as well as one-on-one, interviews with the principal, science teacher, learners (six girls of approximately 15 years of age who were randomly identified by the science teacher), parents (10 women), community leaders, and traditional healers. These conversations were transcribed in accordance with standard principles for developing transcriptions (see Guest and MacQueen 2008).

People shared stories of their personal struggles. For example, a young girl in the community talks about everyday life as follows:

I am 15 years old and I live with my grandmother, Maria Chauke¹. I am not sure exactly how old she is, but she is probably in her late seventies. Grandmother is asthmatic and not well. She has just come back from a week in hospital. My sister and I look after her. We live in the village, where I go to school. My sister is also sick and can't go to school. My mom, Linah Shibambo, doesn't live with us because she works as a cleaner in the city, a two-hour bus ride from our village. She lives with my brother and sister in a squatter camp on the outskirts of the city. Today is my mom's day off. That's when she comes up to the village. We are always very excited to see her. Before she goes back to town tomorrow, she wants to take me to the sangoma² at the hospital. She is worried about my tummy aches because my father died of stomach problems when I was a baby.

By sharing in the everyday experiences with the community, we gained insight into how the community established patterns of interaction, discourse ethics, and a sense of identity. Zubeda Bana (2010) further adds that the sharing of ideas gives confidence to the participants to reflect critically on their existing teaching learning practices.

The girls in this collaborating community were searching for their own identity within their culture. Although they did not literally use the word 'female empowerment' there was sufficient evidence from their conversations to indicate they were seeking empowerment and cultural transformation. Not a single girl indicated she desired a life similar to that of her mother. They were also asked about their perceptions of how the project could be of value to them. This information was used as a starting point to negotiate realistic benefits within the broader context of the purpose and process of meaningful science education. It was quite a challenging approach, because at the time the teachers, girls, and elders could not agree on what they regarded as the major concerns within the community.

When asked about science as a career option, the girls felt science was for men and scientific knowledge could not be applied in a domestic situation and accordingly was not of any relevance to them. One girl complained she wanted a better education and indicated 'The teachers just sit outside and do nothing, and we have to sit inside.' Another girl, who lives alone with her brother, pointed out that she had numerous responsibilities and did not like to waste time at school. All of the girls agreed they did not have time for schoolwork at home, because of all their domestic chores and other responsibilities.

It was also important that the girls knew their opinions were respected and considered. Open-ended questions such as 'What do you like most about the area?,' 'What would you like to change in the school?,' 'What would you change in the community?,' and 'Tell me about your frustrations ...' were asked. These open-ended questions allowed the girls to explain their personal thoughts in their own words. The open-ended responses furthermore allowed the researchers to determine the frustrations and needs in the collaborating community.

Shadowing

In an attempt to fully understand the culture and customs of the school, the technique of 'shadowing' was used to gather data. McDonald (2005) indicates that shadowing is to follow a person throughout his/her different activities over the course of a day. The science teacher and the six girls were 'shadowed' (with consent) to investigate what they did during a typical day in their lives. Five of the girls lived with their mother, grandmother, and siblings and the other girl lived alone with her brother and only saw her mother once a month. Only the latter mother was employed. The other mothers were dependent on social grants, R200 per child per month (approximately \$25/month), as their source of income. One of the girls had a baby boy who was looked after by her mother.

This technique provided the opportunity to convene with the parents, who were mostly mothers, in a different setting. In contrast to interview strategies, in which participants only report on their actions, shadowing provides the researcher with grounding in the participant's 'doings,' and this serves as a starting point for further discussions. The shadowing took place over a period of several weeks; because it was more convenient to do so, the girls were shadowed in a concentrated period of one week (each), whereas the science teacher was shadowed over several (school) day-long sessions. Behaviors, opinions, actions, and explanations for those actions were reflected in descriptive notes. All of the participants were extremely generous with their time and willingness to allow a researcher into their lives and homes.

Through shadowing we were able to get to know the girls, principal, teachers, and other members of the community. Without consciously directing or formalizing our efforts, we gradually transgressed from being 'outside researchers' towards becoming 'insiders' who respected the norms of the community and cared for the individuals. In addition, the participants and the researchers quite naturally and fluidly shared with each other some of their hopes, aspirations, and insecurities in life. We also found that we could readily bend to the emotionality of these relationships, without compromising our integrity, as researchers. In this regard, we have adhered to Kerry Jeanne Tanner's (2005) suggestion that researchers should experiment with alternative ways to access emotion – for instance, narrative techniques such as storytelling and metaphor are becoming established as valuable adjuncts to more traditional research approaches.

Ethical challenges

Britha Mikkelsen (2005) and Nammalvar Narayanasamy (2009) acknowledge there are often issues that pose challenges in community-based research. Britha Mikkelsen states that 'action and dialogue risks stirring unrest since interest conflicts are likely to remain between different groups of participants. In action and dialogue studies, topics and methods are closely intertwined' (2005, 339). Based on the critical research question underpinning this study, a few thorny ethical challenges emerged – specifically with regard to the data collected and the insights gleaned from a comparison between the theoretical perceptions of female empowerment (as derived from the extant literature) and the realities of life in the collaborating rural community.

Throughout the project there were tensions and conflicts that arose from adhering to the methodology and the need to be culturally sensitive. According to Giampietro Gobo (2008), informed consent might be a relatively simple matter in relation to targeted scientific

or survey research; however, in the case of community-based transformative action research, where people are observed and consulted in their natural environment, with the intent of bringing about community transformation, this form of consent cannot always be applied (Malcolm et al. 2009). In this project, consent was an oral agreement based on deliberation, because this was the norm in the community. Participant awareness of the study was provided in a manner that conformed to cultural norms, while ensuring participants were comfortable with the nature of the study. Written consensus was not practical because many of the elders were not functionally literate.

The principle of 'Ubuntu' still applies in the collaborating community. This principle implies that each individual's humanity is ideally expressed through his or her relationship with others and theirs in turn through recognition of the individual's humanity (Broodryk 2002). In other words, people are who they are through other people. In this instance, however, a confounding factor was that contradictory perceptions of 'female empowerment and emancipation' were found among different members of the same community. Some participants perceived the concept as negative and in opposition to the core of their African culture, whilst others expressed as their paramount aspiration nothing more than financial upliftment and the 'city life' (with its western capitalistic connotation). It was difficult to reach a mutual understanding with all of the stakeholders that science education could empower the girls within their own context. Although the African principle of Ubuntu articulates significant ethical values, such as respect, human dignity, compassion, and cooperation, the possible sense of coercion for consensus around such issues fostered tensions of oppression in the context of demands for conformity and loyalty to the group. Failure to conform could be met with harsh punitive measures (Mnyaka and Motlhabi 2015). According to Meshach Bolaji Ogunniyi (2007), a growing rift between new structures and traditional values has seen the erosion of the spirit of Ubuntu, and has made it difficult for people to interact openly in certain instances. Tessa Hicks Peterson (2009) affirms that significant shifts are necessary within education, and by implication teacher education, in order to build a bridge between the local indigenous culture and social change.

A community-based partnership project incorporating an ongoing process of communication and consent offers an ethical solution that is mutually beneficial to both the researcher and the members of the cultural group.

Taking action

We articulated a research endeavor focused upon the central tenants of a socially responsible science education. Theoretically, the research plan was promising; yet a number of challenges emerged throughout the course of the collaborative endeavor.

From the data gathered for the situational analysis, it was apparent that there were many social setbacks in the area. It was also evident that although western values, literacy, and schools had infiltrated the community, indigenous Tswana beliefs and traditions were still predominant. Deep-rooted beliefs in tradition and local customs persisted, as well as a widespread belief in witchcraft. We found some of the local cultural traditions and customs represented the antithesis of social justice, equality, human rights, and empowerment towards women (e.g. the inferior roles and responsibilities of women in the community, polygamy, teenage pregnancy, early marriage, and female initiation practices).

We anticipated that liberatory, relevant science education would encourage critical reflection in the science classroom, which would ultimately transpire to the rest of the community. Moreover, we envisioned that meaningful, relevant education would encourage and promote female empowerment in the area. We also presumed the teachers would have compassion with the learners and an intense desire to ensure learners were engaged actively in the learning process, because they shared more cultural similarities with the learners and were well aware of the challenges the learners face on a daily basis.

The application of liberatory pedagogy in the collaborating school was problematical because there were barriers obstructing the delivery of quality education. Firstly, the teachers did not seem to have empathy with the learners' oppressive living conditions. On the contrary, they complained about the learners. Rather, the teachers focused upon their poor working conditions. The lack of resources at the collaborating school undoubtedly affected the culture of the school in a negative way. Most of the teachers had low levels of job satisfaction and little intrinsic motivation to teach. During the time spent at the school, the teachers often arrived late for school and were not adequately prepared for lessons. In fact, the majority of teachers did not even turn up for class at all. A positive learning atmosphere was non-existent. The irony and frustration was that even though all of the teachers were part of the previously oppressed population in South Africa, it appeared as though they were not particularly inspired to provide their learners with opportunities for a better education.

A negative culture at a school affects the way teachers think about and value their teaching. It also affects the way in which people relate to each other, the way meetings are conducted, the way information is shared, and the general management of the school (Hollins 2015). These factors negatively impact the learners' attitude towards school, as was confirmed during the interviews with the girls. When asked about their likes and dislikes about the school, they unanimously expressed concerns such as 'It is dangerous to walk to school alone and if you are late, you have to stay home.' Another girl pointed out that she had numerous responsibilities at home and did not like to waste time attending school: 'We walk very far (7 km) to school everyday. When we get to the school, the teachers just sit outside and we have to sit inside.' The girls all felt that they could not find time to do their school-related work along with the chores and responsibilities for which they were responsible at home.

Transformations

Initiating change

We sought the cooperation and support of the various stakeholders in the community. Leadership plays an important role in all of these matters. Clearly, principals have the ability to change the culture of a school by translating the vision and mission of the school into achievable action and outcomes. From the interviews with the principal, he was proud of certain things that had been accomplished at the school, even before the current project. For instance, he was very proud of the new classrooms that had been built and the solid structure of these buildings. While the new classrooms were exceptionally nice aesthetically, they were in fact structures without any furniture (desks or chairs) or teaching resources and supplies. The classrooms were a step in the right direction, but with negligible impact upon the quality of teaching and learning at the school. Fortunately, the principal was a highly respected individual who was viewed as a leader in the community. Our social conscience

motivated us to challenge the notion that transformative action research needed to be initiated by the community. According to Randy Stoecker (2005), the outside researcher could be the initiator in the transformative research process; but it is essential for the researcher not to put any words into the mouths of the participants. The familiarity and empathy between the researchers and the participants, as well as the fact that the pupils wanted change, gave us the confidence to confront the principal regarding the negative culture at the school.

On one occasion, Franci and the principal discussed their frustrations about their jobs, families, and lives in general. She explained to the principal that she had grown emotionally attached to the children in the community and that it troubled her that they were not receiving a meaningful education. She indicated to the principal that, based on her responsibilities to the learners, she would be obligated to include such observations in her written descriptions of the project. Initially the principal objected and was reluctant to admit there was a lack of meaningful teaching and learning at his school, in spite of the aforementioned obvious indications to the contrary. Franci asserted that the only way to a better future for all was through education and while she understood the frustrations of the teachers, their role as educators was of critical significance and that she wished to see them fulfill their responsibilities without interference from the educational authorities. The principal thereafter admitted there 'might be a problem' and that the teachers in fact lacked the intrinsic motivation to teach. Together, they agreed that the principal would cooperate in the project and Franci promised to report on any future positive outcomes throughout the duration of the project. The principal also asserted that it was important for him to lead by example and to motivate the teachers and learners accordingly.

Contextual transformations

To initiate change in any organization, including a school, Michael Huberman and Matthew Miles (2013) suggest attending collectively to the physical frustrations first. With this in mind, the principal and teachers were encouraged to communally prioritize aspects that in their view needed to be addressed within the school. They unanimously indicated that better resources and teaching conditions would motivate them to become better teachers. They also stated that the shortage of funds at the school prevented them from purchasing any equipment. The teachers further agreed there was a need for appropriate guidance and teacher support from the education department. In this regard, it must be mentioned that there is a chronic scarcity, especially in rural areas, of experienced education officials to provide teachers with the necessary subject guidance and support. The principal suggested the teachers should collaborate with teachers from other schools by way of district meetings to share their knowledge, experiences, and frustrations. The anticipation was that this collaboration and solidarity would induce higher levels of commitment amongst the teachers. As transformations occurred, the teachers discussed the positive changes within the school. The observations also revealed this to be an effective means of motivation, because the teachers were conscientious with respect to living up to the expectations of fellow workers.

A further change came when a group of third-year science education students from the University of Pretoria became involved in the project. The students were eager to collaborate with the local science teachers, because a community project is a compulsory module in their course. The science teacher agreed to collaborate with the students and he attended

four workshops on creativity and innovation in the science classroom. During these workshops, the teachers were encouraged to utilize creativity and innovation to develop teaching materials from local available resources. These workshops were very effective, because the laboratory is now equipped with local, recycled, and donated material. The science laboratory became an exhibit hall by displaying learners' work on the walls, as well as in other parts of the school. The idea behind the public display of learners' work was to acknowledge that their work was appreciated and valued.

This venture had an extremely positive influence on the morale of the science teacher, the principal, and the learners. As a result of these experiences, the science teacher began teaching science in a very engaging and positive manner. He began to focus upon the educational needs of the students and encouraged active learning. In essence, the experiences were the first time he had the opportunity to participate in professional development oriented towards his specific discipline and he found the experiences most worthwhile.

As a result of the collaboration of the various parties involved, a feeding scheme was established at the school to address the concern of malnutrition. The principal took charge and wrote a letter to the Department of Education to request financial aid for the scheme and the teachers contacted the local supermarkets to ask them for their support. The principal indicated while it took considerable effort to get the project planned and launched, it was well worth the effort. The feeding scheme is now in full operation based on a nutritional feeding plan developed by the Grade 9 students.

The Grade 8 students started an irrigated vegetable garden housed in empty cold drink bottles. A compost heap was established on the school grounds as a science project. Assistance came from a local farmer who donated plants and educated the learners on different types of soil and how to grow a vegetable garden efficiently. The produce harvested from the garden is now contributing to the feeding scheme. The science teacher and learners agreed they had positive bonding experiences by working together in the garden. Three of the girls also indicated that they have started their own vegetable garden at home. These findings are consistent with research showing community gardening projects 'grow' communities (Glover 2004).

The other teachers witnessed the drastic effect of positive collaboration for themselves, which in turn motivated them to address some of the challenges at the school. A sense of community was established among the learners and teachers. This was noted in two respects: in the support gained for the project and in the change of the attitude of the teachers towards the learners. One of the teachers summarized the transformation by saying she is highly motivated towards creating a learning environment where meaningful education occurs.

To address the issue of safety, which was raised by the girls, a community meeting was conducted at the school. The principal offered to write a letter to the local authorities on the matter. A local policeman agreed to talk to the learners about the signs and causes of violence and how to evaluate whether an area was safe. The teachers decided the school grounds should be safe at all times and as a result the school gate is now closed during school hours. In addition, a group of women started a local safety forum that patrols the river area every morning and afternoon. Public discussion opens the space for rethinking problematic issues and for considering options that various concerned parties may see as more meaningful. Carol Gestwicki (2015) points out that the involvement of parents in schools leads to overlapping spheres of influence between the home, school, and community.

Moving forward

The latter part of the collaboration unfolded in three stages: designing, implementing, and evaluating a contextualized, relevant science curriculum unit. The researchers and teacher frequently discussed who should be involved at each step and why. The local stakeholders provided information and insight regarding culture, attitudes, beliefs, and values, as well as potential barriers to achieving the stated objectives. This facilitated the identification of appropriate learning materials and activities that would be relevant in the community. Community-mindedness towards the project was established as parents came to realize that relevant, contextual science education could be extended beyond the science classroom and they now deemed it an asset to the community, to 'serve the community in some way.'

Sharing knowledge

We invited the community to a meeting at the school to debrief the community activities that transpired and to seek feedback. The meeting was organized as a two-way process, whereby findings were presented and explained by the researchers and a discussion with the community was encouraged. A variety of issues were discussed, but the recurring theme focused upon recommendations offered by the community for the future upscaling of project initiatives. What emerged from the feedback was a clear message that the collaboration was perceived by the majority of the community as a positive experience.

The philosophy espoused by this project was that stakeholders and researchers should co-create knowledge that is realistic and pragmatically useful and is rooted in local understandings (Greenwood and Levin 2005). This meant that the learners, teachers, and community members had to be involved in all stages of the project. Constructing shared understandings of knowledge acquired and envisioning the way forward represented important steps in the collaborative venture.

Conclusion

What initially drew us to this project was the potential of science education to encourage and enhance social justice for girls and women in a rural, high-poverty community. It is our belief that education in general, and science education in particular, is a powerful vehicle for facilitating social transformation in high-poverty communities in developing countries (Kyle 1999, 2006; Onwu and Kyle 2011). The Millennium Project has identified 15 global challenges facing humanity that 'provide a framework to assess the global and local prospects for humanity' (Glenn, Gordon, and Florescu 2009, 10). Issues related to the status of women are among the 15 global challenges. According to Malhortra and Schuler (2005), the encouragement of female empowerment as a development goal is based on a dual argument: social justice is an important aspect of human welfare and is intrinsically worth pursuing; and female empowerment is a means to other beneficial ends.

The contextual data revealed there were clear-cut conflicts between 'female empowerment' and the traditions and educational status quo in the community. We suggest that in such a setting any sustainable attempt to promote female empowerment through science education should regard the following as essential: the community's support, supportive peer relationships, skills in decision-making and problem-solving, and relevant scientific knowledge. The whole process, however, pivots on motivated teachers who should be able to connect the content knowledge with the local context in a creative and engaging manner.

As indicated earlier, in practice this was not readily attainable in this research project. At the start of the project the research topic was neither initiated nor supported by the community. This forced the researchers to review and challenge certain principles confined to the methodology, in particular regarding their approach as initiators in the process. Freire ([1970] 1993) points out that the educator should educate for freedom and for the creation of a new social, political, and economic order. The educators were not equipped for this task in this case. The researchers were therefore constrained personally to act as the agents for change by initiating all of the measures and means referred to, which in turn contributed to the contextual transformations in the community. At the outset of the project, as ‘outsiders,’ the researchers were not a part of the community’s culture, politics, or traditions. However, the outsider status enabled the researchers to both collaborate with the community and at the same time provide a fresh, independent perspective to the challenges in the community. At times, this fresh, independent perspective opened the door to deliberation and reflection around issues regarding whether to maintain the status quo.

This collaboration shows that transformation in a school within a rural community can be achieved through the development and maintenance of a constructive inter-relationship between the human and organizational components and the physical infrastructures. Even though not all of the challenges acknowledged by the community have been addressed, progress has been made on issues of interest and concern to the community. The physical improvements had a ripple effect, which had a positive influence on the attitude of the teachers, learners, and community members towards the rest of the project. For most of the participants their impetus to empowerment was not a conscious decision. Instead, it was inspired by identifying and addressing physical challenges. These physical improvements acted like a catalyst for the empowerment process and led to two vital transformations in the community: individuals came to understand their own capabilities better and they discovered that they did have the power to take action and transform their community.

Notes

1. All names cited in the study are pseudonyms.
2. Traditional healer.

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