

**COLLABORATING TO REFORM
SCIENCE EDUCATION IN CONTEXT:
Issues, Challenges, and Benefits**

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Within recent times, the call for collaboration among stakeholders in education has been made with increasing frequency. In current thinking, community building and collaboration are posited as critical elements in school reform. The literature reveals various models for initiating collaboration. There is the model that describes the initiative for collaboration as undertaken by “researchers”/university personnel. A second model describes the perspective in which schools as organizations invite researchers to collaborate on a project. The Reforming Science Education in Context (ReSEC) project is an example of the first model. This paper reports the issues that emerged in forging collaborative relationships among two lower secondary science teachers at a selected New Sector High School in Trinidad and three members of staff from the School of Education, UWI, St. Augustine, during the period September 2005 to July 2006. It also presents the benefits and challenges associated with the process of collaboration, which aims to achieve a school-based agenda for education.

Introduction/Background

Reforming Science Education in Context (ReSEC) is a project that was developed out of an expressed need by teacher-participants attending a mini-symposium hosted by the School of Education (SOE) at the St. Augustine Campus of The University of the West Indies (UWI), which was held in February 2005. The purpose of the symposium was to discuss the findings from an investigation of the status of science education at the lower secondary level in Trinidad and Tobago, which had recently been disseminated (see George, 2003; Herbert, Rampersad, & Akinmade, 2003; Rampersad & Herbert, 2003), with key stakeholders including officials from the Ministry of Education (MOE) and science teachers. The findings from the lower secondary project indicated that many schools had implemented the new national lower secondary school curriculum in science (Trinidad and Tobago. Ministry of Education [MOE], 2002), which had been developed in 2002 by the Curriculum

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Development Division of the MOE as part of the Secondary Education Modernization Programme (SEMP) reform thrust. Part of the discussions at the symposium focused on teachers' responses to this new curriculum in terms of its usefulness in addressing students' learning needs, in fostering inquiry and higher-order thinking skills in students, and in guiding teachers with respect to strategies for instruction and assessment. In particular, the teachers were encouraged to speak about any challenges they faced with respect to the implementation of the curriculum, and were asked to identify areas in which they needed help.

While the curriculum itself was commended by most teachers with respect to its objectives, general organization, good articulation among the levels, range of activities and assessment strategies, user-friendliness, and so forth, many of the teachers present expressed the view that they either had to "*re-design the syllabus to suit the needs of [special] students,*" or "*students with special needs seem to be left out,*" or that the "*syllabus did not cater for the mixed-ability groups,*" or that they experienced difficulty in "*getting weaker students to remain motivated.*" A few also commented that while the curriculum document suggested activities that had the potential to promote higher-order thinking skills in students, they themselves needed to "develop skills in thinking in order to pass it [sic] on or teach students." They also felt that while the newer "SEMP" schools were well-equipped, many of the existing schools had limited resources to adequately support science teaching, or to give students the opportunity to engage in practical activities.

The teachers were facilitated in the development of individual action plans to address issues raised, and a formal offer was subsequently made by the science educators at the SOE to the teachers and their principals, indicating willingness to collaborate on the implementation of these plans. There was no response to the offer of collaboration, either by the teachers themselves or their principals. The comments of the teachers and their action plans (copies of which were requested at the symposium), however, provided sufficient stimulus for follow-up action by the science unit at the SOE.

We, as science educators at the SOE, believed that we could not sit idly by and do nothing when there were perceptions that education was "in crisis," and when reports indicate that a large percentage of students fail examinations each year or leave school with deficiencies in the areas of literacy and numeracy. There was a need for some kind of intervention. We were wary of moving forward with a predetermined research agenda since this approach has not found favour with teachers. The literature shows that classroom practitioners perceive that university-generated educational research is of no relevance to them or the

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practicalities of everyday teaching, and do not look to such research to inform and improve their practice (see Sweeney, 2003). Another view expressed in the literature (see Greenwood & Levin, 2000) points to a role for the university that moves it from ivory tower status to full and complete participation with practitioner-stakeholders in society. The latter approach pointed to a way forward, and was in keeping with one of the seven strategic objectives of the St. Augustine Campus of UWI which speaks to developing relationships with stakeholders. Accordingly, the ReSEC project was designed.

The ReSEC project was formally conceptualized at a meeting of science educators of the SOE in June 2005. The meeting was held primarily to discuss the issues raised at the mini-symposium, prioritize them in terms of their importance, and formulate a plan of action for collaborating with science teachers in the new SEMP schools to make the new curriculum more responsive to students' needs. Specifically, the formalized objectives were:

- To gain insights into the challenges faced “on the ground” in the implementation of the national science curriculum
- To work with teachers in dealing with these challenges
- To work with teachers to generate science teaching/learning resource materials that would be useful in the context of these schools and similar schools
- To assist in the development of a cadre of “master science teachers” for the lower secondary level

Criteria for choice of schools, and strategies for initiating contact and inviting teachers to be part of the collaborative initiative were explored. It was envisioned that the first phase of such a collaborative project would take three years, working with teachers from Form 1 (the first year of secondary school for students between the ages of 11–13 years) and following through to Form 3.

The purpose of this paper is to report on the issues involved in initiating and implementing the preliminary phase of the ReSEC collaborative action research project. There are very few reports on the processes involved in this preliminary phase, but what exists characterizes the phase as “messy” (Bello, 2006, p. 16). However, very little detail on what constitutes the “messiness” has been reported. This report is intended to address this deficiency.

The issues reported on in this paper emerged from the data as interpreted through the conceptual lenses/frameworks of the university participants. What emerged as issues were influenced by contextual

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factors such as the history of school/university relationships, the specific interactions that occurred as the project evolved, and our own personal and professional experiences.

Some Theoretical Perspectives

The literature on collaborative action research may be explored from a number of perspectives. The theoretical underpinnings that informed the study are: conceptions of collaborative action research, establishing communities of practice, social constructionism, and models of collaborative action research.

Piliouras, Kokkotas, Plakitsi, and Vlaxos (2003, p. 1) suggest that “the adjective ‘collaborative’ in collaborative action research stresses a research methodology that involves researching with teachers rather than conducting research on them or about them.” Further, they state that underpinning their own action research study is the assumption that “teachers can acquire the expertise necessary for effective curriculum development, by refining and extending the practical professional knowledge they already possess through critical collaborative activity supported by a team of researchers” (p. 1).

Greenwood and Levin (2000) refer to the process of collaborative action research as *co-generative inquiry*” because it is built on professional researcher-stakeholder collaboration. They make a strong case for a role for action research in connecting university social research to some of its primary social constituencies, thereby contributing to a positive restructuring of university-society relationships. In essence, they are advocating a reconceptualization of the university’s agenda. Clarken (1999) identifies elements that can serve as a guide to determine university/school readiness for collaboration and identify potential barriers to success. These are:

- trust/responsibility
- time/commitment
- accountability
- choice/ownership/meaningfulness
- shared vision/beliefs
- mutuality/reciprocity
- flexibility/adaptability
- challenge/openness to growth
- respect and communication/sensitivity

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However, this reconceptualization can only be realized if participation in action research is seen as both a means of supporting research in teaching and an essential element of the research itself (Bruce & Easley, 2000).

The literature also speaks to collaboration and community building as critical elements in action research and school reform. Communities of practice have been defined as groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (Wenger, McDermott, & Snyder, 2002, p. 5). They further suggest that such communities share information, insights, and advice; ponder common issues; explore ideas; and act as sounding boards. Wenger et al. also posit that good community architecture invites three main levels of community participation. These are a “core” group, who move the community along its learning goals; the “active” group, who participate regularly but without the intensity of the core group; and the peripheral group, who remain on the sidelines observing but not actively contributing. They further suggest that community members move through these levels as their interests are stirred.

The social constructionist perspective also underpins the action research paradigm. The underlying assumptions of social constructionism are that reality is constructed socially, and that meanings and knowledge are co-constructed in interaction (Shotter, 1993). Shotter posits that the social constructionist approach does not allow communication to be seen as simply a matter of information transfer and exchange, but rather as a process by which people can, in communication with one another, literally inform one another’s being. Research from this perspective focuses on communicative transaction as complex, dynamic, and context-dependent (Souza, n.d.). Beck and Kosnik (2006) see social constructionism as an approach that encourages all members of a learning community to present their ideas strongly, while remaining open to the ideas of others. Therefore, in forging a successful community, issues such as agency, knowledge, and power must be addressed.

The literature suggests that there are three types of knowledge that are each associated with different dimensions of power. These are representational knowledge, which is linked to power of competence (*power-over*, i.e., power to control); relational knowledge, linked to power of connection (*power-with*, i.e., in solidarity with others); and reflective knowledge, linked to power of confidence (*power-from-within*, i.e., power to act on moral values) (Park, 2001). Starkhawk (1987), cited in Park (2001), sees these three dimensions of power as being operative

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and necessary in community-based actions. However, reports in the literature are somewhat silent on these issues as experienced in practice.

Attempts at collaboration reported in the literature reveal various models for initiating collaboration. In one model, the initiative for collaboration is taken by “researchers” (see Bello, 2006; Grove & Fisher, 2006). In another, schools as organizations invite researchers to collaborate on a project (see Cooper & White, 2006). But it is evident that there are some limitations in the reporting of action research studies in education. In a critique of these studies, Grove and Fisher state that they provide an incomplete picture, with some being more descriptive than analytical, and others providing few details on the process of implementation. They also refer to the lack of clarity in research reports about the factors that lead to collaborative relationships. Bello, citing Gomez (1990), speaks to the under-reporting of the process aspect of action research. She posits that at the process stage hardly any “results” are perceived and, in research, efficiency and tangible results have been given priority over the educational value of processes (p. 4).

The ReSEC project is an example of the first model (Bello, 2006; Grove & Fisher, 2006). It attempts to change the relationship between the SOE and the secondary school, and to respond to the call by Cochran-Smith and Lytle (1993) for the inclusion of the voice of teachers in developing a knowledge base of teaching.

Method

The process of establishing the collaborative project began with the purposive selection of one SEMP school, based on ease of access to the teachers, the attendance of one of the teachers at the science symposium on February 10, 2005, and proximity of the school to the university campus. Negotiating entry was relatively easy because of a personal relationship between one member of the science unit and the principal, who herself had participated in programmes at the SOE. She was contacted, and an initial meeting was arranged. Three members of the university team explained the project—its genesis and rationale—and obtained permission to proceed. A meeting was then held with three members of the teaching staff—two females and one male—of the science department. Two of them were at the time teaching Form 1 science and one had taught Form 1 science in the past. The project idea was presented and the two Form 1 teachers—one male and one female—agreed to participate.

The female teacher (identified in the report by the pseudonym DC) was assigned to the One Special class, referred to as 1S, comprising

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students who had scored between 0% and 30% on the Secondary Entrance Assessment (SEA). SEA is a national examination that is written by primary school students at 11+ and used to assign them to secondary schools. The male teacher (identified in the report by the pseudonym NB) taught the regular Form 1 class referred to as 1R, comprising students who had scored above 30% on the SEA examination.

The female teacher (DC) had 10 years teaching experience. Before assuming the position at the school at which the research was conducted, she had taught at two other schools. She had obtained a B.Sc. in Agricultural Science and was a trained teacher. DC had obtained the Agriculture Teachers' Education Centre (ATEC) diploma for teaching Agricultural Science and had recently been awarded a diploma in technology education. She was also the Head of the Department at the time of the research. The male teacher (NB) had been teaching for 3 years, was untrained, and had obtained a degree in natural sciences with a major in chemistry. Before embarking on teaching as a career, NB had worked in a science laboratory in industry. Neither teacher had been exposed to the methodology of action research. Both are married and are parents.

Three members of the science unit of the SOE participated in the research. The most senior member of the team (JG) had been employed at UWI since 1983, and at the time was a Senior Research Fellow. Prior to employment at UWI, this participant had taught chemistry at the secondary level for 10 years. The other two participants joined the staff at UWI in 1996. One (SH) had 15 years of experience of teaching general science and chemistry at the secondary level. The other (JR) was a biology teacher with over 25 years experience at the secondary level. In addition, this participant had served in an administrative position at the secondary level.

The Research Procedure

The research group comprised three university participants and two classroom teachers. The first step for the university participants was becoming familiar with the school context. This involved observations of science lessons and engaging teachers in after-class conversations. At the beginning of the process, each teacher was observed by all of the participants from the university and after-class conversations were held. As the project evolved, each teacher participant worked with a member of the university team, who observed classes and engaged in the after-class conversations with the teacher. In addition, the university

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participant who worked consistently with the 1S teacher also taught the class on a few occasions. Materials were produced to support classroom teaching, either by the teacher, teacher in collaboration with laboratory technician, or teacher in collaboration with university participants. At intervals, the entire group met for purposes of reviewing, planning, and reflection. These meetings also served as opportunities for building interpersonal relationships. On one occasion, all participants met at the university for an informal get-together, which included lunch.

Data were therefore gathered from classroom observations, reflective conversations, and planning sessions. Classroom sessions and meetings were audiotaped and transcribed. University participants also prepared field notes and were therefore the instruments for data collection. The data were analysed by university participants using a theoretical framework, for example, Clarken's (1999) elements of collaboration, and a grounded theory approach to determine other emerging issues

Emerging Issues

Two main issues were addressed as the collaborative process evolved. These were related to "perceptions of power differentials" and "clarification of the research process." Attention to these issues was required as we sought to "get it right."

Reducing the Perceptions of Power Differentials

A number of issues related to collaboration emerged. In the context in which we worked, we were aware that perceptions of power were inevitable. JG stated explicitly: "*I know I was aware of the power thing as perception.*" Perceptions of power differentials was an underlying concern because we were aware that attempts at collaboration within organizations and among stakeholders require the development of trusting relationships, which can facilitate freedom of expression. In a context in which we had entered uninvited, but in which we were nevertheless accommodated, and aware of the perceived differences in status of university lecturers and secondary school teachers, we took steps to smoothen the path to meaningful collaboration. The following illustrates our efforts at deliberately addressing perceptions of power differentials.

When we began the project during the first term of the 2005 academic year, most of the meetings were held on the school compound at the teachers' convenience. For example, we arranged meetings during their non-teaching periods or after school had been dismissed. We sought to

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have the process work in a way that would establish that we were partners in the process, as we attempted to build a trusting relationship.

Partners in the process. During the first meeting (20 September, 2005), we provided a background of the work leading to the conceptualization of the project and expressed our desire to collaborate with the teachers. The following illustrates:

JG: Before we could do anything we need to get you on board...We would work with you. We could plan together, share ideas, sit in on classes...really a collaborative effort over this 3 year period.

We tried to emphasize that we would be equal partners in the process.

SH: I just want to stress that we would be working together. We would really require a lot of your input.

At one point during the meeting a teacher asked: “*Exactly what are you all going to do?*” The following shows how one university participant communicated our orientation towards partnership with teachers:

JG: We don't know. When I say we don't know, it's the kind of project that evolves. I can tell you what our big goal is. Our big goal is to work with you.

At the beginning of the second term (January 2006), we invited the teachers to UWI for lunch, at a time that was mutually convenient for all parties. At this meeting, we engaged in a discussion that would allow us to establish a joint purpose for the project. After lunch, we reflected on the progress made on the project during the first term, and made plans for the second term. Based on the first term's experience, we thought that we could have suggested some project objectives to kick-start the discussion, for example, to gain insights into the challenges faced “on the ground” in the implementation of the national science curriculum: “to work with teachers in dealing with these challenges,” and to work together to establish a joint purpose—one in which all parties had an input. At this stage, while we were focusing on the process of reform, the teachers were focused on a product such as a “new” curriculum, as the dialogue below illustrates:

JG: That's how we see it. We don't know if that's how it will play out. So those were our objectives.” ...Is there anything that you don't agree with? Anything that should be added? We are open. These things are not carved in stone. We can change as we see fit.

DC: What would be the outcome of this? Would it be a new curriculum?

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As the meeting continued, one university staff member raised the issue of ways of addressing one another. She suggested a change in the level of formality that we had used at the start of the project:

JG: So maybe in the context of this then, you, Mrs. C and you Mr. B....And before I go to that, I'm wondering whether we should not shift to a first name basis...It's something for us to think about...So in the context of this, maybe D. and N. could give us some feedback on the Term 1 teaching experience and working with us.

We were always cognizant of the entry process—that we had proposed the idea of collaboration. Hence, when the project began, our focus in these early stages was to consistently communicate the message that the teachers would have direct control over the manner in which the project evolved. From the first session (September 2005), during which the project idea was introduced, and at follow-up meetings in October 2005, we as university researchers tried to facilitate the process of collaboration as much as possible with explicit signals for teachers' ideas and input:

JG: We thought that it was necessary to chat with you to see where you are coming from, what your goals and aspirations are for the class. And most importantly what contribution you think we can make ... because that has to come from you.

During the meeting in January 2006, we as university participants again tried to facilitate the process of collaboration as much as possible by being flexible with the time for meetings and the venue selected:

JG: So work it out and let us know, but I would really welcome that- to be in the school and get more into it.

DC: Is Tuesday good for you?

NB: For me too.

JG: So let's work for Tuesday, yeah.

All: Yeah.

DC: Tuesday 31st January?

JR: And we're looking at what time to start? 2.00 p.m.?

The teachers' role in action research was also highlighted and shown to be an integral part of the process of collaboration:

SH: Actually we are working with you, but we are not the only ones researching.

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NB: Yes, I understand. If I try an approach, I can think about how it was done. Can it be done better?

SH: A lot of reflection on your part.

Building trust. Honesty is an integral part of developing trust in a relationship. The SEMP science curriculum is designed to incorporate topic areas in the separate sciences which are supposed to be integrated during the teaching/learning process (MOE, 2002). There is a bit of a paradox here. On the one hand, the curriculum document is titled “Integrated Science” and places emphasis on integration during the teaching/learning process. This is in keeping with current research which speaks to the removal of the traditional disciplinary demarcations (see, for example, Sweeney & Seal, 2008). On the other hand, topic areas are in the separate sciences, and teachers have little or no exposure to integrated science during their academic preparation. University graduates from the UWI, the pool from which the majority of science teachers in Trinidad and Tobago is selected, read for higher degrees in one or perhaps two of the traditional science disciplines. This means that both teachers and teacher-educators could be challenged by some aspects of the syllabus. One university participant was forthright about these limitations:

JG: I know I was aware of the power thing as perception. One of the things I tried... was to tell the truth. I don't know the biology so in that sense he (NB) had it all, 'cause I'm not a biologist.... But I realized it's the system we live in, you know, especially when you preface the names by Dr. this and Dr. that. It sets up a kind of dynamic, which is really not what we want.

During the meeting JG also stated explicitly, “*We know we haven't got it right yet, but we would really like some very frank feedback.*” This statement provided the space for open, honest communication. Subsequently, one teacher (DC) felt safe enough to share information about feelings of tension she experienced when SH observed the classroom sessions. “*When I have someone in my classroom, it is obviously a tense moment, even though I did Dip.Ed. That's always a little struggle there.*”

Being open about the perceived power issue, honest about our deficiencies, and facilitating teachers' openness served to set us on the path to establishing a climate in which perceptions of power differences were diffused over time, though they were not entirely eliminated. Therefore, to deepen the levels of trust, we revisited our communication strategies, especially those that would facilitate our movement from

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university participant as expert to university participant as learner and collaborator in this particular context.

We had entered the context with the intention to be equal partners in the collaborative process, and thus to learn from and with the teachers as a strategy for reforming science education. The manner in which we attempted to build trust and create opportunities for learning to occur and for shared decision making about science curriculum was determined by the specific interactions in which we were engaged. For example, SH, who was working with a trained and experienced teacher, adopted strategies that respected the teacher's practical and professional knowledge base. Examples of how this was done are presented below.

During the after-class discussion of the science lesson held on 25 September, 2005, SH suggested that worksheets/activity sheets could be developed for use in the class. The following excerpt illustrates her use of questioning as a means of suggesting new ways of operating in the classroom. Significantly, the excerpt also reveals that the idea of collaboration was cemented. The teacher used the pronoun "we" in the sentence "We could try that."

SH: But do you think that they would be able to work with each other in groups... if they were given some information? Information related to the factors or the conditions required for photosynthesis? If they were given a little worksheet or activity sheet with some pictures? Do you think that they would be able to work in groups to come up with what is required for photosynthesis? And what is photosynthesis?

DC: They would be able to work in groups.... Yes, they could but that would have to be over a series of classes. I don't think that they could come up with a conclusion in one class...We could try that. Do up a worksheet.

Towards the end of the conversation, SH also sought clarification on how they should proceed in developing the worksheet and offered assistance in the production of the worksheet:

SH: So is there anything... Do you think that you would make the worksheet? I don't know if you would want any input. I mean, if you would want any input from me or from us...Or do you think that you would have to conceptualize what you're doing?

DC: Initially before you suggested it I had planned to do a little experiment...to make sure they understand.

SH: ...What I'm saying is if you produced the worksheet and you wanted to have it copied, we would try to help with the resources...

DC: The school has money. No. We have lots of paper.

Power Differentials Surface

Yet despite attempts to reduce the impact of perceptions of power differences, we were not always successful. For example, there were occasions when we felt that we were intruding. During the conversation of 25 September, 2005, Mrs. C mentioned that she had changed her plans to accommodate SH's scheduled visit. She did not consider cancellation as an option, giving the impression that she did not consider herself as an equal partner. The following illustrates:

SH: So when did they get the results of the test?

DC: They still have to.... I don't know...I didn't have time to do that yet (sighs). It's just dragging on. I couldn't give them today because that would have been a whole lesson. I don't want to waste your time. So I put it off. We'll see what happens.

Feelings of intrusion also surfaced when we met with teacher participants for the after-class conversations. In the absence of an official meeting/conference room at the school, we met in the library on most occasions. However, with the required rearrangement of furniture or student dislocation to facilitate such meetings, we sensed some unease on the part of the librarian. Although permission was always given, it appeared that we were really inconveniencing the library staff.

Incidents such as these led to reflections on the process of establishing collaborative relationships within a school setting. For example, we pondered upon questions such as: Who should be involved in the process of establishing a collaborative project in a school? Did the approach adopted inadvertently reinforce perceptions of power? Furthermore, when we noted that we were the ones initiating contact, we recognized that the one-sided communication was an indication that the issue of power differentials had not been resolved.

One-sided communication. One of the main factors impacting upon any collaborative project is communication (When do we meet? How often? Where do we meet? How do we maintain contact? What do we discuss?). Our different locations within the education system and the competing pressures of workplace responsibilities were challenges that emerged. DC said: "*It will have to take a high priority because there are lots of other things going.*" During the early stages of the project (October 2005), SH and DC had planned to work together to produce a worksheet. SH suggested to DC that that they should communicate via the telephone. DC suggested communication via e-mail.

However, the priorities of workplace responsibilities, such as accommodating changing school schedules, reduced the time available

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for preparation and feedback, and DC did not initiate contact either by telephone or by e-mail as she had suggested. Consequently, the worksheet referred to above was prepared without the collaboration intended. During the second term, SH became involved in teaching one class. Accordingly, two-way communication was even more crucial to ensure that her plans were congruent with the teacher's plans, and that the students had the necessary prior knowledge or skills required for the lesson. The following reflective entry, written in February 2006, also illustrates the pattern of the one-sided nature of the communication process that was a recurring theme:

I called DC on Friday morning to express my concern that the students would not be ready for a lesson on chromatography as we had planned. After reflecting some more I felt that it would be more logical to do a session on evaporation as I had initially planned after the lesson on crystallization on Thursday. She said that there was no science class on Thursday and mentioned her disappointment that again when she is responsible for an aspect of the plan that there is no follow-up. (Last week Thursday, D was supposed to introduce the students to the use of the spatula in preparation for my class on 14/2/06 and this was not done). I therefore expressed my desire to do the session on evaporation on 21/2/06 instead and that I would go ahead and prepare the worksheet with this in mind.

We interpreted the lack of initiative in making contact as evidence of teacher participants' continuing discomfort with the process of collaboration or as a means of redistributing power. It was only by the beginning of the first term of the second year of the project that one of the teachers began to initiate contact. JR reports on such contact in September 2006 via e-mail to one of the university participants:

I heard from N yesterday. He has been assigned two Form 1 classes, and has requested (as part of the collaborative process) that I meet with him to engage in planning for these classes. He is free for one period tomorrow morning, so I promised to meet with him at 9.40 a.m. I know that you operate on a tight schedule now, but I was hoping that you could join us and share your ideas.

The above illustrates some of the challenges that were associated with perceptions of power. But two other issues emerged during the early phase of the project. One was "impatience with the collaborative process;" the other was "clarification of the research process." A discussion of these two issues follows.

Impatience With the Process of Collaboration

During the second month of the project, we, the university participants, began to construct a deeper understanding of the collaborative process. The attempt to collaborate led to personal insights about human frailties impacting on researcher as instrument. For example, the following comment, during the early phase of the project (October 2005) when DC indicated that she would prepare a worksheet, illustrates that SH was willing to circumvent the processes involved in developing a collaborative relationships, in order to expedite results.

SH: But if it's [help is] not required. Well, great. It means that we won't have to make an arrangement about when we would meet to drop off the worksheet and so on.

The teacher's independent actions removed the obstacles associated with (a) arranging convenient times for face-to-face meetings, or (b) using technology for communication. While this results-oriented approach may have served to move things along, independent action reduced the level of collaboration.

The project therefore served as a medium for university participants' learning at many levels. As teacher educators, we had not hitherto collaborated with other stakeholders in the manner dictated by the project. As such, we had to learn how to surrender control and to develop trust in the process. Further, the teacher participants had not been engaged in research in this way before, so we also needed to "clarify the research process" at intervals, as we collaborated on the project.

Clarifying the Research Process

During the preliminary phase of the project, it was necessary to discuss the research process on numerous occasions. This was particularly important because we did not plan separate sessions that dealt exclusively with research. During the first meeting (20 September, 2005), the action research process was described as follows:

JG: The kind of research we're really talking about is called action research where you research as you work and you analyse your research data as you work and you use the results of your analysis to put back in your planning and you work it during the cycle.

However, there was evidence that teacher participants did not fully understand the research dimension of the project. During the meeting of 4 October, 2005, one of the teachers sought further clarification on the research focus.

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NB: The action research, what would it entail? Like what is involved in the research? ...Is it looking at the classes, looking at inputs? Is it that you get information and experimentation ... is it like that? I'm trying to picture what it is like. I can't really...

JG: I think I need to start from the beginning again. Because it is not like you described.... Maybe what we should do next time is to bring a little bit of literature on action research so you can read about it.... If it were the other kind of research we would tell you these are our objectives and stuff like that.

We did follow-up with the literature and, in addition, we presented a framework to assist teacher participants as they reflected on lessons taught. The forms were intended to induct teachers into the data collection process. By reflecting and writing about specific teaching issues, the teacher participants would have data to share with us and together we could work towards addressing the issues of concern. But up to the point of preparing this report, the time available and the school context did not allow us to help them to understand fully their roles in the data collection and analysis procedures.

Even though there were challenges associated with establishing and engaging in the process of collaborative research, there were benefits derived from the said process. Some of the benefits are discussed below.

Benefits

From our perspective, there were benefits accruing to the teacher participants and to us—the university participants. The teachers had the opportunity and support to reflect on their practice and we—the university participants—learnt valuable lessons that would enhance our future interactions with teachers in their own school environment and in the university classroom. Each benefit is discussed in turn.

Teachers reflect on their practice. After-class conversations provided opportunities for teachers to reflect on their practice, and, hence, to identify issues for concern, propose solutions, act on them, and reflect on their actions. From our perspective, teachers' involvement in reflection on their teaching was a benefit, and the following illustrates how teachers' reflections led to modification of the science curriculum.

After seven months of collaboration, a discussion between teacher participants and university participants in May 2006 revealed that both teachers had modified their practice to facilitate student learning. The 1S teacher reflected on her actions in the classroom, and her comments show that she had refocused her science teaching by placing more

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emphasis on students' development of science concepts and less emphasis on developing basic literacy skills, such as writing and spelling:

DC: In delivery, using a new approach I am using more worksheets to provide more structure. This gives more time for teaching and student activity. The downside is that students may lose the worksheets, but I try to ensure that they place the worksheets in their books for review.... May compromise on literacy skills (since students have less opportunity to write out everything), but there is more time for science. Literacy can be left for the remedial group. The focus is on having students enjoy and understand the science.

The 1R teacher had expressed interest in using students' prior knowledge as the vehicle to increase the level of student-centredness in the classroom. In other words, he intuitively felt the need to put constructivist theory into practice:

NB: Trying to use students' prior knowledge. This is a new area for me. I used to tell them everything. With the clarification on the use of notes as a teaching strategy, I bring on more activity. [I try to] develop notes with the students. Moving from too much explanation to using more visuals...not too T-centered, using the visuals to help students make sense...I am still challenged about what might be the ideal activity, and making links is the hardest challenge for me. I am trying to formulate ideas, but am still not sure. I like the idea of moving from concrete to abstract.

University participants learn from experiences. For example, DC's modifications of the curriculum were based on (a) her desire to meet the perceived needs of the students by providing concrete concepts, (b) her recognition of the importance of having students establish links (relationships) among concepts, and (c) her intention to have students discern the relevance of the material studied to their everyday life experiences. Her concerns about the abstract nature of the concepts to be introduced were expressed in the after-class conversation in October 2005, as follows:

DC: Well I decided to continue with plants and look at more concrete things. All right. So I say I branched off from the cells. I basically finished with that because I'm not going into too much detail...We looked at the organism as it pertained to well man...so I thought I'd try to connect the two looking at a living thing and then move on into parts of plants that they could see and touch—concrete.... I wanted

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them to know that not only animals and man but [also that] plants are made up of organs... make sure that they make the connection.

However, the influence of the written curriculum document surfaced as the conversation progressed. She expressed the view that she should introduce ideas that would have prepared students for what was to come. The following dialogue illustrates:

DC: I want to touch everything before the end of the year.

SH: When you say everything...?

DC: The major topics. They have to do matter and energy... microorganisms. I don't know if I really want to go into that.

SH: But why do you want to touch everything?

DC: Well so at least they'll be a little more prepared when they get into Form 1. You know?

Based on the interactions with the teacher participants, we began to understand the nature of the tension that emerged when the teachers attempted to be faithful to the curriculum document [fidelity approach to curriculum implementation] and, at the same time, attempted to modify the curriculum in response to students' needs. For example, even though DC taught a 1S group with special needs, for which there was no written curriculum, she felt that she should introduce all the topics that were intended for the regular Form 1 classes. In addition, teacher participants did not feel empowered to make changes to the national curriculum. For example, DC needed clarification on whether the outcome of the collaborative process would be a new curriculum, given that teacher participants worked in a context in which the MOE usually sanctions changes to curricula. We therefore learnt the following:

- The stronghold (even stranglehold) of the national curriculum and officialdom
- The difficulties teachers face in adopting new roles—even an experienced teacher like DC
- The hidden (or not so hidden) agenda that all students must cover the same material (as exemplified by DC in particular)
- Power of contextual variables

The above shows that the issue of modifying a national curriculum to meet diverse student needs is not as straightforward as it might seem. This knowledge is very important, as there are implications for teacher development programmes.

Discussion

The findings from this study bear some similarities to, and show some differences from, those reported in the literature. Some of the similarities are related to the patterns of participation that emerged. For example, in spite of our attempts to reduce perceptions of power differentials, such as time for socialization, we (the university participants) perceived that initially the power dimension between the teachers and the university participants was one of power-over (control) (Park, 2001). Similar views have been reported by Fetters and Vellom (2001). They stated that teachers “were leery of working with the university. They did not want university personnel to come in and take over” (p. 74). In addition, our attempts to establish mutuality and trust are similar to the retreats mentioned by Grove and Fisher (2006). Other significant similarities were those related to the constraints of time available for collaboration within the current structures of the public school system and the university, and the uncertainties associated with the initial phase of the collaboration process. Bello (2006) describes the initial phase of establishing collaboration as “messy.” It can be posited that this messiness is the period required to resolve and to reconstruct perceptions about others before true collaboration can begin.

Most of our interactions (social and/or professional) are predated by historical antecedents. These in turn give rise to perceptions about the interacting parties and shape the manner in which the interactions occur. In the particular interactions reported on in this study, which aimed at collaboration, the antecedents include the history of development of the school and the university as institutions within the Trinidad and Tobago context. Since none of the participants entered the collaborative relationship in a vacuum, it is natural that the perceptions of the participants involved would have mediated the interactions and contributed to some of the messiness that occurred.

As we strove to adopt the principles of collaboration (Clarcken, 1999), it was evident that we proceeded differently from some researchers in the international setting. For example, Grove and Fisher (2006) reported an approach that seemed to retain a top-down dimension. They stated that “goals for participants were further developed at a weekend retreat” (p. 57). In this study, we attempted to establish egalitarianism by facilitating “a joint purpose.” As was reported earlier, we were “aware of the power thing as perception,” and this perception provided the conceptual framework that guided many of the processes and procedures that were enacted. Another difference that must be taken into account is the context in which this study was conducted. As is commonly reported in the

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literature, (see, for example, Bello, 2006; Grove & Fisher 2006), participants involved in similar action research projects had prior relationships with the researchers or had been exposed to action research programmes, which might have facilitated the process.

Alongside the challenges involved in establishing a true collaborative relationship, some benefits were evident. With respect to the development of the reflective habit, the literature suggests that teacher reflection can contribute significantly to transforming practice. The process of reflecting provides teachers with knowledge that informs future actions and improves the quality of science teaching (Carr & Kemmis, 1986; Elliot, 1991; Lincoln, 2001). As teacher educators, we perceived that some transformations had occurred based on teacher participants' explicit comments and observed actions.

Further, the experiences gained from teacher participants' attempts to transform the science curriculum, along with the ensuing tensions/conflicts, provided some insights for our own practice. In-service teachers with whom we interact often comment that the curriculum as written does not meet the needs of many of their students. We have often recommended that they adapt the curriculum, but we did not have first-hand experience of the issues involved with following such prescriptions. The results of this study show that curriculum modifications are not as straightforward as they may appear. With the insights gained, we are now better placed to develop strategies to help teachers in our professional development programmes to deal with the philosophical, technical, and context-specific dimensions involved. For example, one approach might be to be more deliberate in helping teachers to make the curriculum more adaptable to diverse student abilities; to pay more attention to contextual issues such as urban/rural differences, cultural variations, and so forth. We may also strengthen the aspect of the programme that draws upon teachers' personal theories as we help them in their personal, social, and professional development, and focus more consciously on the technical skills required to implement a range of classroom instructional strategies. In retrospect, this preliminary phase of the project has allowed us to gain insights into the challenges faced "on the ground" in the implementation of the national science curriculum (our first project objective), and to begin the collaborative process to facilitate our second objective, that is, working with teachers to deal with these challenges.

Participation in the project also led to a new level of collaboration among stakeholders, and also saw an increase in the membership of the community of practice. For example, the laboratory technician moved from the position of an outsider, to a peripheral member, to an active

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member of the group (see Wenger et. al., 2002). This is an example of the dynamic nature of the community that emerged and the level of comfort that had eventually developed among the members of the group. The level of interaction among university participants themselves was a reflection of a changing culture—from one of cooperation in which an individual accepts and works along with another's ideas to a sense of community and shared mission in which there is input from all parties to set the agenda for action (see Bruce & Easley, 2000).

In conclusion, our interpretations of our interactions with teacher participants were influenced by our perceptions, experiences, and so forth. At the beginning of the process, our interpretation of teacher participants' perceptions of power was the concept of power as control, that is, by technical means that derive from representational knowledge. However, as we interacted with teacher participants and as the project evolved we began to develop a different understanding of the conception of power—one that did not involve control only. This new understanding incorporated a more liberating concept of power, which embraces solidarity and self-confidence as well as control, as advocated by Park (2001). By engaging in this process, we were able to reconstruct our understanding of the collaborative process and become more conscious of cultivating reflective knowledge as we work towards co-constructing the concept of power as confidence (power-from-within) (Park, 2001).

The learnings from this research project are instructive for the future of university/school collaborations in the area of curriculum reform within the Trinidad and Tobago context. Power differentials, along with associated issues of trust-building and communication modes, are inevitable when there is the perception that the knowledge brought by any one party has greater value or currency. The process of developing meaningful collaborative relationships in such groups therefore requires time and the requisite dispositions of openness, honesty, and commitment from all concerned, since there is no easy solution to attaining optimum collaboration. We recommend that further action research projects of this nature be conducted if we are to increase our knowledge and understanding about reforming science curricula within the Trinidad and Tobago context.

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