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A QUALITATIVE EVALUATION OF THE LOWER SECONDARY SEMP SCIENCE CURRICULUM OF TRINIDAD AND TOBAGO

Dorian Barrow and *Jerome De Lisle*

Timely and systemic evaluations of educational innovations continue to be two challenges faced by education reforms in Trinidad and Tobago (T&T). This paper is, therefore, an attempt to counter this pattern by placing in the public domain a report of a small-scale evaluation of 24 randomly selected science teachers in T&T. A focus group interviewing technique was used to evaluate the teachers' stages of concerns and their levels of use of the new lower secondary science curriculum—a curriculum initiative launched in 2002. Using the Concerns-Based Adoption Model (CBAM) and grounded theory as the theoretical frameworks, an analysis of the focus group interviews of the science teachers revealed that these teachers had very high levels of concerns with the innovation, that is, they had thought critically about some of the major issues surrounding the innovation, but had very low levels of use. However, because the study involved a small sample of science teachers' views (n = 24), the findings should, at most, be considered exploratory, and therefore must be subjected to later verification using some quantitative or mixed methods curriculum evaluation techniques on more samples of science teachers.

Background

The Secondary Education Modernization Programme (SEMP) is a major undertaking by the Government of the Republic of Trinidad and Tobago (T&T). This new education reform project was conceived and developed in the latter half of the 1990s, and was finalized, funded, and launched in 1999, in time for the 2000 World Education Forum in Dakar. Its stated aim is to reform the secondary education system of the country.

In this regard, SEMP can be considered as the latest wave of secondary education reforms in T&T, which had its origins some 30 years earlier. In 1968, the Government of T&T took the position that secondary schooling would no longer be only for a privileged few, but would be the right of every eligible child successfully exiting its primary education system (Alleyne, 1995). However, constrained at the time by limited physical infrastructure and trained personnel, the Government took a phased approach to the implementation of this new access to secondary schooling policy.

Consequently, in the decades following 1970, the Government, in an effort to actualize this mandate, constructed some 29 three-year junior secondary schools. It also built additional five-year secondary and four-year senior comprehensive schools to augment the elite state and denominational secondary schools in existence at the time. Additionally, in this wave of secondary education reforms, the Government introduced a “shift” system. In this system, the new secondary schools admitted two cohorts of students, with one cohort attending classes in the morning and a second cohort in the afternoon. In time, with the construction of the additional secondary schools and with a shift system in place, more and more students who would not have gone on to secondary schools were being encouraged to do so.

SEMP, then, can be considered as one of the latest vehicles by which the Government of T&T is attempting to renew and expand the process of secondary education reforms in the country. At the same time, SEMP is also being used as a framework to address those other important complementary matters of equity, quality, access, and efficiency that have arisen over the last 30-odd years in the education systems of the Anglophone Caribbean in general (Sweeney, 2003) and T&T in particular.

One of those issues has been, and continues to be, the lower secondary science curriculum, that is, what science is taught, and how that science is taught, to all students in Forms 1, 2, and 3, since there has never been a common standard parallel to the standards of science taught in Forms 4, 5, and 6 (Grades 7–9). In this new reform thrust, a major aim of the state has been to develop in all secondary school students what the Ministry of Education (MOE) has described as “scientific capability” (Trinidad and Tobago. Ministry of Education [MOE], 1998). *Scientific capability* is the label the Government has given to the eclectic notion that all graduates from the secondary education system of T&T must be what historically has been described as being *scientifically literate*. Graduates from a secondary school system are considered scientifically literate according to the international literature when they possess the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity (National Science Teachers Association, 2003).

Scientific capability, like scientific literacy, highlights even more clearly the focus of science education for action, personal satisfaction, and enlightenment. It includes five interrelated, though also somewhat distinct, outcomes—competence, curiosity, understanding, creativity, and sensitivity. Hence, the Government's vision of scientific capability not only encompasses the epistemology of science, but also emphasizes the skills, resources, and perspectives that are transferable to domains outside of science (MOE, 2002; Ramkissoon, 2007).

According to Pamela Fraser-Abder (1985b), the pursuit by the Government of T&T of some version of this vision of scientific capability in all secondary school graduates may have begun as early as 1977, with new developments in primary science education in T&T. She noted that despite the existence of the primary science syllabus of 1956 and 1975, little science had been taught in primary schools. In 1977, the MOE and the School of Education of The University of the West Indies (UWI) launched an elementary science curriculum development programme—Science – A Process Approach for Trinidad and Tobago (SAPATT). This curriculum was developed for children 5–12 years old, and involved 700 teachers in its development from 1977–1983.

In another article, based on a paper presented at the 1981 Annual Meeting of the National Association of Research in Science Teaching, in which she described a study that she had conducted to determine the status of cognitive development of primary school students of T&T, Fraser-Abder said that: "secondary science curriculum developers in Trinidad and Tobago will have to make some effort to achieve some match between the cognitive demands of the curriculum and the cognitive levels of the students" (1985a, p. 5). This suggests that as early as 1981 there may have been some preliminary science curriculum development work being undertaken in Trinidad and Tobago, which was trying to link the competencies that the secondary science curriculum was developing in students to their cognitive developmental levels.

By 1994, a lower secondary school science curriculum with scientific capability as one of its major goals was in place, ready to be piloted. The National Certificate of Secondary Education (NCSE) Science programme was designed for the lower secondary schools, and was introduced by the MOE in 25 pilot schools in September of 1994. An evaluation of this pilot initiative by George (1997) found that the programme was having an impact on the science experience of students at the lower secondary level. She reported that many students were enjoying science, had a good idea of what the discipline entailed, and wanted to continue studying science beyond Form 3.

The nature of the impact of this programme, however, appeared to vary depending on the orientation of the teacher. In her report, George (1997) noted that teachers in the junior secondary schools seemed to value most the fact that the programme attempted to relate science to the daily lives of the students. Those in 7-year schools valued the emphasis placed on the nature of science and the work of scientists, as well as the development of science process skills in students. However, she further noted that the extent of the impact appeared to vary depending on the commitment of the teachers to the programme. Additionally, she reported that: "some of the problems identified in the programme [were] related to the syllabus itself, while others were contextual problems" (p. 13).

The contextual problems were not limited to the science pilot alone. For the whole NCSE pilot programme it was found that:

> A major shortcoming of the Pilot Project was the failure to design and make provision for formal evaluation of the programme before implementation, so that feedback of empirical data could be provided on an on-going basis. The lack of adequate monitoring systems, as well as insufficient time to observe the process, severely limits the ability to provide an in-depth analysis of the running of the programme. (MOE, 1998, p. 15)

The report went on to strongly suggest that the programme be suspended unless all its recommendations were accepted and fully implemented.

Following this report, the NCSE pilot initiative was suspended and subsequently replaced by the SEMP programme initiative in 1999. The lower secondary SEMP science curriculum, along with seven other core curriculum subjects, was developed in three stages. The first stage of the curriculum development process consisted of stakeholder consultations held with representatives from a cross-section of the national community. In the second stage of the process, the officers of the Curriculum Development Division (MOE) studied the reports of the consultations, together with the 1996 Education Policy Paper and the reports of the Curriculum Task Force and the Task Force for the Removal of the Common Entrance Examination, "as well as newspaper articles and letters to the editor on education over the past five years" (MOE, 2002).

Finally, at the third stage, 10 existing schools were identified to pilot the new curriculum. Science teachers were drawn from these schools to form a Curriculum Writing Team. Other teachers with specific subject or curriculum development skills from other schools were also included in the team. In this phase, specific science learning outcomes were identified, and content, teaching, learning, and assessment strategies were developed to support these outcomes. The science curriculum document to be evaluated here was the outcome of these efforts.

Purpose

This study was designed to provide some insights into the perceived value of the lower secondary SEMP science curriculum to a small but diverse sample of secondary science teachers. Additionally, the study sought to determine the implementation status of this science curriculum in 24 of the 140 secondary schools in T&T, and to recommend possible ways forward for these select schools with respect to the successful implementation of this curriculum innovation.

The 24 teachers who participated in the study were selected from large and small schools; urban, semi-urban, and rural schools; single-sex and co-educational schools; three-year, five-year, and seven-year schools; and prestige and new sector schools. Hence, all school types in the country were represented in the sample. The individual assessments of the 24 teachers were aggregated and a composite view of their concerns and their levels of use of the SEMP lower secondary science curriculum was generated.

Though no attempt was made to generate a system-wide view of teachers' levels of concerns or level of use of the innovation, the authors used this opportunity to speculate about some of the implications that the findings might have for science education reforms in the wider secondary school system of Trinidad and Tobago.

Methodology

Because of resource and time constraints, the study had to be limited to only 24 secondary schools and 24 science teachers. There are approximately 140 secondary schools in T&T, so that a sample of 24 schools represents 17% of all the secondary schools in the country. Furthermore, schools in T&T are distributed in varying numbers in the eight education districts of the country, with several types of secondary schools located in urban, semi-urban, and rural sectors of the country. These include government secondary, assisted secondary, junior secondary, senior comprehensive, and composite schools (T&T. Central Statistical Office, 1998). The sample of schools used in this study included at least one of each type of school, from each of three geographical locations—north, east-central, and south.

Following focus group protocols outlined by Richard Krueger (1988), and capitalizing on one of the researchers' intimate knowledge of the secondary school system of T&T following 20 years of experience working with the system in various capacities, the study brought together 24 teachers who had been implementing this new SEMP science curriculum in their schools over the period September 2002 to June 2007. They were placed in three separate focus groups of eight teachers per focus group. The following screening process was used to select the 24 science teachers:

1. The school principal of each of the 24 four schools identified was contacted and the project was introduced, with supporting documentation to verify that this was a MOE initiative.
2. Each principal was asked to recommend two science teachers who could speak authoritatively about the school's experience with the lower secondary school SEMP science curriculum. It was stipulated that these teachers had to have had direct experience with teaching the curriculum in at least one of the form levels.
3. From the 48 nominees, the research team selected 24, one from each school, to form three focus groups of eight science teachers each. One group consisted of science teachers who worked in schools in the north, the second group consisted of teachers who taught in schools in the east and central, and the third group was made up of science teachers who taught in schools in the south of the country. Each of the focus groups included teachers with approximately the same mix of teaching experience, gender, and content area specialization.

The three groups met in two-hour sessions for approximately six hours on the same day at a common location in central Trinidad. Graduate students from the School of Education with training and field experience in moderating focus group sessions were tasked with moderating the sessions following a brief orientation. Each focus group had two moderators and one of the researchers was on site to coordinate the sessions. Each focus group, through the moderators, was asked the following eight key questions:

1. What is your overall impression of the lower secondary SEMP science curriculum?
2. How is the lower secondary SEMP science curriculum different from the general science syllabus it has just recently replaced?
3. How can the curriculum be improved or revised?
4. How do you judge the curriculum in terms of meaningfulness of its content and activities?
5. How integrated is the SEMP science curriculum?
6. What do you understand to be the specific outcomes of each of the three levels of the SEMP lower secondary science curriculum?

7. What are some of the challenges you are facing in implementing the curriculum?
8. What do you see as some of the specific barriers to implementing the curriculum?

Each question was discussed until the moderators felt that the group had reached data saturation point, at which point they would move on to the next question. All sessions were audiotaped and the moderators took field notes. The tapes were later transcribed, and the transcripts checked for accuracy. Transcripts and field notes were used as the basis for the content analysis of the data (Berg, 2007; Creswell, 2004).

Analytic Framework

The two researchers were solely responsible for the coding and the analysis of the transcripts, which were, in part, grounded in codes generated from the focus group data,. However, they were also interpretive, in that codes were also "borrowed" from a conceptual analytic framework—the Concerns-Based Adoption Model (CBAM)—which was viewed as consistent with, and helpful to, this type of applied research. Consequently, the coding frame used to analyse the data comprised of a mixture of grounded codes and codes borrowed from the literature (Berg, 2007; Oppenheim, 1966; Strauss, 1987).

Several themes emerged from a qualitative analysis of the related coded sections of the transcripts. The themes generated could be grouped under one of two major categories, namely: teachers' concerns about the new curriculum; and teachers' levels of use of the new science curriculum. The emergent themes under these two major categories were then further examined in light of the codes generated from the CBAM framework (Hall & Hord, 2001).

As was indicated above, only parts of the CBAM conceptual framework were adopted in generating the coding frame used to analyse the emergent data. This decision was made in part because the CBAM framework was developed to explain teachers' concerns about innovations, and to explain why educational innovations were not always adopted and used as extensively as innovators intended, which parallels the situation in T&T. To do this, CBAM uses three conceptual frameworks, namely Innovation Configurations, Stages of Concerns (SoC), and Levels of Use (LoU). In this analysis, codes were adopted from only the latter two conceptual frames.

Stages of Concerns (SoC) address the affective side of change, that is, the teachers' reactions, feelings, perceptions, and attitudes to the new SEMP science curriculum. Levels of Use (LoU), on the other hand, "has to do with behaviours and portrays how people are acting with respect to a specified [innovation or] change" (Hall & Hord, 2001, p. 81). Hence, only these two dimensions of the analytic framework were adopted as the study sought to explore the affective outcomes as well as the behaviours of the science teachers as they adopt and implement the new SEMP science curriculum, and to diagnose their progress in implementing the innovation.

Most significantly, these dimensions of the CBAM framework were selected from the many other change models available in the education evaluation literature because other curriculum evaluators who have used the framework attest to Hall and Hord's claim that "[CBAM] makes it possible to understand and predict what is likely to occur with people in change and to determine whether a new innovation was making a difference" (2001, p. 81).

Findings

Affective Outcomes: Teachers' Concerns

The answers the teachers provided to those questions that reflected their stages of concerns were derived from a qualitative analysis of the relevant episodes of their respective focus groups' conversations and the moderators' field notes. Several themes emerged from the analysis of the related coded sections of the transcripts. Where possible, the moderators' field notes were used to triangulate the findings that emerged from the transcripts. An elaboration of these themes, or affective outcomes, forms the basis of the summary evaluation of the science teachers' concerns.

Satisfaction: The first clear theme to emerge from an analysis of the transcripts of the focus groups sessions was that of satisfaction with the new SEMP science curriculum initiative:

> I wouldn't say that the SEMP science curriculum is ambitious. [What] I would say is that it is innovative, [especially] in bringing out the philosophy that all children can learn and in keeping with that philosophy, which I totally agree with and I hold on to that notion. [However] one of my concerns is [with] the course assessment. *(Teacher I, Focus Group I*)

Though most of the teachers from the focus groups were generally impressed with the new SEMP science syllabus, especially with its philosophical orientation and its activity base, some teachers thought that the curriculum was not balanced, "*being too heavy on certain topics*." Others felt that there were too many topics to cover in a year, and that the syllabus was not sufficiently integrated. Still others felt that there was a mismatch between the proposed teaching/learning strategies and the evaluation strategies, while others felt that "*several important things …have been left out of the syllabus document*." However, despite this string of "consequence concerns" (Hall & Hord, 2001, p. 62), the general consensus of the teachers who participated in this review was that this new SEMP science curriculum was not only different from the "*old science syllabus it has replaced, but was also substantially better*."

Essentially, the teachers felt that the SEMP lower secondary science curriculum is better than the old science curriculum it replaced, partly because "[it is] *so different from the old curriculum*." These differences were more pronounced in some areas than in others. For example, although the old science syllabus covered more content material and was better integrated, it was in fact organized as a set of prerequisite courses for the Caribbean Secondary Education Certificate (CSEC) science syllabuses that students take in the upper secondary school. The "old general science" curriculum, therefore, was not as holistic in its approach to the science education of students as the SEMP science syllabus. This is so in part because the SEMP science curriculum is a cohesive programme that is projected over the entire five years of the students' secondary school life.

Furthermore, the old science syllabus prioritized breath over depth of content, and so it was not as focused as the SEMP programme on engendering in students such critical competencies as the scientific literacy and science inquiry process skills "*that the CXC would like the students to have*." Additionally, the SEMP science curriculum had some unique features to specifically address the needs of special students, that is, to address those Form 1 Special (1S) students who are socially promoted from primary into secondary schools without the appropriate academic and literacy skills regarded as necessary at the secondary level. All of these may have contributed to why the teachers felt that the SEMP science curriculum catered to a much wider range of student abilities than the old general science syllabus it replaced.

Challenges: Even though the teachers felt that the SEMP science curriculum is substantially better than the previous general science curriculum it replaced, the second theme to emerge from an analysis of the focus groups' transcripts is challenges, that is, the strong sentiment that the innovation still posed some new, and old, challenges to science teachers. One such problem is that it challenges secondary school teachers to extend their own science content knowledge, as this teacher with 12 years experience points out:

> To me if we are going to extend to where we're looking at providing students with quality education, I feel very strongly that you have to seriously narrow the gaps in teachers' science knowledge…. I am not saying that is the situation *[now]*, just that teachers need as much help as possible. *[For example]* if you are looking at mixtures, chemical changes, etc. and you are a physics person, you need the help of an experienced chemistry teacher. If somebody is not experienced, for example, when I started to teach, I was the only chemistry teacher on staff, there was nobody to help me with anything. So when you have nobody to go to, you learn these things by making mistakes, trial and error, practising on the children, sending them out there with half the knowledge they should have and so on. *(Teacher I, Focus Group III)*

This challenge might in part exist as a consequence of how teachers are appointed to teaching positions in secondary schools in T&T. Because secondary school science teachers enter the teaching profession usually just after they have completed a B.Sc. degree in some specific science discipline (e.g., chemistry, physics, biology), it is not unreasonable to assume that their content knowledge of other science fields may sometimes be limited.

Furthermore, the focus groups' transcripts suggest that many of these 24 science teachers' attitudes to this challenge were: "*this topic is not a part of my subject area, so I don't know much about it myself. How do they* [the significant others in the society] *expect me to teach something I barely know myself*?" Some of these teachers in their focus group discussions even admitted to "*not feeling comfortable with teaching content outside their field*." Teachers also adopt several untenable pedagogical strategies, such as resorting to the chalk-and-talk method of teaching science. By teaching in this disjointed manner whereby science is presented to students at times as inquiry and at other times as "telling," teachers convey mixed messages to students about the nature of science and how scientific knowledge is constructed, instead of the meaningfully coherent message about the nature of scientific knowledge the SEMP syllabus intends to be conveyed to them.

Another challenge that the new SEMP science curriculum poses for teachers is how to proceed with integrating the various topics into teachable coherent science units. As currently constructed, these science teachers do not view the SEMP science curriculum as integrated. Technically, these teachers consider it more a "*combined than an integrated science curriculum*." By a combined science curriculum, teachers mean that the content of the syllabus is made up of topics from the fields of chemistry, physics, biology, and earth/space science, and that these topics are only "*loosely stringed together under the headings of Living things, Matter and Energy, etc. etc*." Because most science teachers have not been exposed to how to teach science in a multidisciplinary, interdisciplinary, or integrated manner (Glasgow, 1997), the levels of integration of the SEMP science curriculum varies from school to school, and sometimes even from teacher to teacher within schools.

Additionally, the teachers claim that what further compounds the task of integrating the SEMP science syllabus into coherent teachable science units is the way the curriculum topics are sequenced. For example, Form 1 topics like the "Cell" and the "Particulate Nature of Matter" are sequenced too early, since at this level many of the Form 1 students do not have the prerequisite knowledge and skills "*to appreciate these topics*." Lastly, the teachers found that the topics in the SEMP syllabus are not sequenced in the "*best way to fully engage students in an optimal way*." Hence, even though most of the teachers do not find the SEMP science syllabus to be very dense [a few of the teachers sampled do], that is, it is not mandating that a lot of outcomes be covered in a relatively short period of time, they cautioned that whether the outcomes could actually be achieved over the three years also depended on the quality of the school's student intake. The schools that take in a lot of academically weak students, the teachers claim, would most likely be the most challenged to meet the standards of the outcomes set by the curriculum.

Leadership: The final theme to emerge from the analysis of the focus groups' transcripts was leadership, that is, a yearning for a new type of curriculum leadership. The teachers, especially those who have participated in science curriculum innovations in the past, spoke about "*wanting to get this one right*"; about "*us learning from our mistakes of the past*"; and of "*the Ministry doing things differently*." They would, for example, like to see more "*regular and direct involvement from the Ministry*" in these reform initiatives. They also would like to be supported in more concrete, even "*more mundane*" ways. For example, some teachers would like to see some model lesson plans added to the curriculum document, or to the resource booklets that are expected to accompany the SEMP science curriculum document in the future. Furthermore, some teachers, like the one quoted below, need help in how to introduce and develop an engaging science lesson:

> Listen to what she said. She is right. In terms of teaching the objectives, we could have a set induction so we could know how we should be introducing the students to each objective and from that we

> could build the content. It would help us a lot if for each objectives we get that set induction. *(Teacher 1, Focus Group II)*

In essence, this last emergent theme suggests that these teachers are crying out for help in those practical areas such as how to use a curriculum document in planning and organizing for instruction (Quinn, Haggard, & Ford, 2006), that is, with unit and lesson planning.

In summary, the teachers had nine major concerns, mostly in the management and consequence domains:

1. The SEMP lower science curriculum is not balanced.
2. The curriculum covers too many topics.
3. The topics are not properly sequenced to engage the students in an optimal way.
4. The curriculum has left out some "big ideas" of high school science.
5. The teachers feel uncomfortable with the way the curriculum challenges them to expend their pedagogical content knowledge.
6. The curriculum is not sufficiently integrated.
7. The onus of integrating the topics into coherent teachable units falls on the shoulders of the teachers and they feel that they lack the training/competence to carry out this task properly.
8. There is a mismatch between the curriculum's recommended teaching/learning strategies and the strategies that the MOE uses to evaluate the students in the NCSE examinations.
9. The curriculum lacks features that specifically address the concrete needs of some science teachers.

Hence, the affective side of the change process that these 24 science teachers are experiencing as they implement the new SEMP lower secondary school science curriculum can be characterized by three themes, namely: a sense of satisfaction with the new curriculum; the feeling of being challenged by some aspects of this innovation; and a sense of yearning for new leadership, that is, hoping that this time around the support provided by the leadership of the innovation (invariably the MOE) will be much more substantive.

Using the CBAM framework as the lens, one sees that the affective side of the change process that these science teachers are experiencing as they implement the innovation would be categorized as at the levels of management and consequence concerns (Hall & Hord, 2001). That is, most teachers' attention at this point in the implementation process is focused on the processes and the tasks of using the innovation and the best use of information and resources. Consequently, issues related to efficiency, organizing, and managing, and the time demands associated with the implementation of the curriculum are of utmost importance to them at this stage.

At the same time, the teachers' attention is also focused on the strategic impacts the new curriculum innovation is having on the students in their immediate sphere of influence, even though they spend a considerable amount of their time thinking about the relevance of the topics for their students; how best to evaluate student outcomes, including performance and competencies; and on adjusting different topics to make them more teachable.

Ultimately, the hope of the MOE, as articulated for example in the SEMP science curriculum document, is that teachers will go beyond the management and consequence stages of concerns to those concerns of collaboration and refocusing (Hall & Hord, 2001). The latter level of concern would be where the science teachers' focus shifts to coordinating and cooperating with other science teachers in their schools, as well as those in other schools, regarding the use of the innovation, and even to the elaboration of more universal benefits from the innovation for both teachers and students, including the possibility of major changes or replacements with a more powerful alternative to the existing SEMP science curriculum.

This notwithstanding, it might still be fair to say that the science teachers have made significant progress in responding affectively to the change process associated with this innovation, given the relatively short period of time over which the innovation has been introduced and the "cautious" manner in which it has been implemented.

Given their current levels of reflective engagement with this innovation, it is also reasonable to say that the teachers have adjusted in a satisfactory manner to the affective demands of the curriculum change process (Rakes & Casey, 2002), given the history of teachers' affective responses to science curriculum innovations in Trinidad and Tobago in the past (Fraser-Abder, 1985b). This is especially encouraging since the records show that in the past, teachers' affectivity to change has been at such low levels that many of the innovations have had to be abandoned after a few years.

In the past, many science teachers, especially more experienced teachers, have been unable to find effective ways of dealing with the affective dimensions of the change process. This study further validates the common-sense notion that one obvious way of overcoming this challenge is to bring practising teachers together to talk about their concerns with the innovation, in part to have them find out for themselves how widespread their concerns are (Rakes & Casey, 2002) and, at the same time, to provide them with opportunities to map out a common path forward. Before we look at what these 24 teachers are suggesting as the way forward, we first have to examine their levels of use of the new SEMP science curriculum in their schools, that is, how affectivity translates into behaviours.

Behavioural Outcomes: Teachers' Levels of Use

This section explores the teachers' behaviours in the classroom as they implement the new curriculum. It seeks to portray how the 24 science teachers are behaving as they seek to learn about new practices for teaching the new science curriculum to their students. Again, the answers the teachers provided to those questions that reflected their levels of use of the SEMP science curriculum in their classrooms were derived from an analysis of the relevant episodes of the respective focus group interviews using the CBAM conceptual framework. Where possible, these outcomes were triangulated by the field notes of the moderators. Themes consistent with those predicted by the CBAM model, as well as other themes, emerged from this analysis. A further elaboration of these themes, or behavioural outcomes, forms the basis of the discussion that follows.

Hall and Hord (2001) have identified and verified, through their 25 years of research, "eight classifications, or levels, of how people act or behave with change" (p. 81). They have argued that since "levels of use deals with [teacher] behaviors it is possible to develop operational definitions of each level" (p. 82). Although their eight levels of use are fundamentally hierarchical, that is, going from the lowest level of "non use" through the "mechanical use" median to the optimal use of "renewal," the adaptation to levels is not necessarily linear and a person's level of use may vary by context.

Of the eight levels of use, the one that seems to best characterize these 24 science teachers' current classroom levels of curriculum use is Level III, or Mechanical Level of Use. This quote from Teacher 2 was typical of how the teachers categorized their level of use of the new SEMP curriculum:

> I am having problems daily with the way the syllabus has been presented. *[For example]* some of the things they have listed as concepts are not concepts. I don't know what they are, but under the section "Concepts" there are some things there that are not really concepts. *[Furthermore]*, some *[teachers]* by me had trouble understanding, for example, how they have the specific outcomes broken down into inquiry skills, conceptual understandings, etc

> …It's kind of confusing for people to understand. *(Teacher 2, Focus Group III)*

As can be discerned from the text above, at this level the teachers focus most of their efforts on the short-term, day-to-day use of the curriculum, with minimum or no time spent on long-term strategizing and reflection. Furthermore, as Hall and Hord (2001) point out:

> changes in use are made more to meet the user [teacher] needs than client [student] needs. The user is primarily engaged in a step-wise attempt to master the tasks required to use the innovation often resulting in disjointed and superficial use. (p. 82)

However, this mechanical level of use of the curriculum by the teachers must be placed in the context of the potential for other levels of use, both higher and lower. At one level, the use of the curriculum is stabilized. On another level, the teachers are just preparing for first-time use of the innovation. Here, teachers are varying the innovation to increase its impact on students within their immediate environment. On another level, the teachers have little or no knowledge of the innovation, have no real involvement, and are not doing anything towards becoming involved. Hence, their mechanical level of use is more a central tendency (an average) rather than an exclusive categorization.

It is important to note that nearly all of the 24 science teachers are clearly mechanical level users of the new SEMP science curriculum and that this level of use is characterized by a wide variety of behaviours. The significance of this is that it provides some insights into some of the actions that the MOE must take if they are to help to move teachers beyond the mere mechanical level of use of the curriculum in their classrooms.

This evaluation, though limited in its scope, does suggest that such a facilitation must take into account that science teachers in general, and these 24 science teachers in particular, are experiencing, at varying intensities, different combinations of the nine challenges identified in the previous section while at school. Furthermore, facilitators in the future must realize that these teachers' low mechanical level of use is in part a consequence of how teachers are responding to the challenges, or levels of concerns, they are experiencing at their respective schools.

The recognition of this link is especially important since this mechanical level of use of the curriculum is further confirmed by many other classroom behaviours exhibited by these teachers. For example, many of these 24 science teachers constantly find themselves having to select which of the many topics to include in their teaching and which ones to leave out. Some of these teachers complain that that this "*is sometimes done on a daily basis*."

Future facilitators will also have to become aware of another common behaviour in which these teachers are engaged, that is, matching the cognitive and psychomotor demands of the topics in the curriculum with the mental ages and skill levels of their respective students. Many of these teachers support the claim that this teacher makes: "[that] g*enerally …the cognitive and skills demands of many of the content topics of the new syllabus are beyond the reaches of many of their Forms 1, 2, and 3 students.*" Some teachers further complain, as this one quoted below, that even after they have eliminated those topics they are still finding that they "*cannot successfully cover all the remaining topics in the three years allotted.*" Hence, as a consequence of this low mechanical level of use, the full implementation of the SEMP science curriculum is being compromised in many of these 24 schools.

What then are some of the other specific barriers that are preventing these teachers from moving beyond the low level of mechanical use of the SEMP science curriculum in their schools? One of these barriers is contextual, the others being: the teachers themselves, the students, the subject matter of the curriculum, as well as other elements of its design.

Contextual barriers include the administrative bureaucracy of the school. The teachers who participated in the study have found that the levels of administrative bureaucracy at the school impact significantly on how extensively and, consequently, how successfully the new SEMP curriculum is being implemented. This, the teachers say, is especially so when it comes to the matter of securing the material resources needed to implement the programme. They report that in those schools where administrators are efficient at securing the materials, the implementation process is much less frustrating to the teacher. Additionally, the speed with which the school administrator can get the MOE to deliver on the physical infrastructure needed to successfully implement the programme, including such needed facilities as functional science and computer laboratories and audio-visual rooms and equipment, is also very important. Again the teachers' claim is that "*schools with administrators who have been able to get these facilities built and operational are currently poised to proceed more smoothly to* [higher levels of curriculum use], *than those schools that are experiencing these 'bureaucratic inefficiencies.'*"

Some of these teachers, however, have pointed out that: "*even in some of the schools where the administrators have been efficient in securing the resources and in putting the physical infrastructure in place* *use of the SEMP science curriculum by the teachers*" is not even fully operational at the CBAM's mechanical level. In such cases, some of the teachers have suggested that "*there are at least two additional counter forces at work*." The first is that many of the science teachers in those school have not been provided with the opportunity, or have not taken advantage of the opportunity, to learn to use the material resources to support the programme's learning outcomes.

Secondly, because the new curriculum requires "*considerable time to be spent by teachers on out-of-class planning and because some teachers do not possess good time management skills,*" many of the required pre-planning activities never get done. As a result, "*some* [of these teachers] *have not even fully operationalized the SEMP science curriculum*" at the mechanical level. It must be noted that those teachers in the sample who have been able to manage their time to do the required pre-planning activities have been implementing the SEMP curriculum more effectively at the mechanical level than those who are saying that they "*cannot find the time to do the required planning.*"

Hall and Hord (2001), claim that the first step in determining whether any new curriculum is making a difference is to determine if the curriculum is being used. Hence, this section of the evaluation has attempted to make that determination within this microcosm by aggregating the individual assessments of 24 science teachers from 24 different secondary schools. While this small sample of teachers does limit the study, it does identify some consistent themes that might be found in a system-wide view of the extent of the use of the SEMP lower secondary science curriculum in schools in T&T.

One possible projection from this micro study to the system-wide view would be that the curriculum is being used in all the secondary schools, but that the level of use is low. Viewed through the lenses of the CBAM framework, these teachers are suggesting that system-wide the new science curriculum is possibly being used at the mechanical level in most of the secondary science classrooms in T&T. It must however be emphasized that the caveat here is that this study involved small samples of science teachers in three focus group interviews, and as such cannot be considered a representative sample of the targeted population groups. As a result, this finding must be considered exploratory and must be subjected to later verification.

One possible implication of this, however, is that though the new science curriculum is being used widely in schools, it is not being used at the optimal levels intended. The broad picture that these 24 teachers paint, if projected on to the wider system, is that science teachers often use the curriculum in disjointed and superficial ways. Most of their efforts are spent on short-term, day-to-day use, with little time for reflection on the impact the curriculum is having on their students. When they do make changes to the curriculum what we should find, if this projection is borne out, is that it is more to meet their needs than their students' needs, as they are now just attempting to master the many and varied tasks required to teach the new curriculum. Hence, if in doing the more extended study this turns out to be the case, their efforts could be characterized as being fragmented, step-wise, and short-term, that is, mechanical.

Another implication of this finding is that other key interventions must be put in place if the level of use of the innovation is to advance to the intended level of "Renewal" (Hall & Hord, 2001), that is, the level where the science teachers are involved in the re-evaluation of the quality of use of the innovation. This is where they seek modifications of, or alternatives to, the present curriculum to achieve increased impact on their students' learning of science. Furthermore, use of the curriculum at this level will significantly increase the probability of teachers enabling students to become more scientifically capable. But to ensure that this occurs, other key interventions are needed if the reforms are to achieve their ultimate stated goal of wanting science teachers to constantly examine new developments in the fields of science education and to proceed with confidence in exploring new goals for themselves and the wider education system (MOE, 2005). A few of these needed interventions are proposed in the final section of the paper.

Conclusion and Recommendations

The concluding section that follows highlights, in their own voices, some of the teachers' recommendations on what those key interventions might be, and, where possible, an attempt is made to reference these recommendations in the literature

> If they could put the practical activities in the front of the curriculum document, that would help most teachers to think a certain way. It is not about getting the content across, it is about trying to get the students to think a certain way and understand and love what it is we are teaching them and at that point you putting them first instead of putting yourself first. *(Teacher 3, Focus Group II)*

Most of the 24 science teachers who participated in the focus group interviews are aware of the low level at which they are using the new SEMP science curriculum in their classrooms, and would genuinely like to move to those levels of use where, as Teacher 3 above put it, they are "*putting them* [students] *first instead of putting yourself* [teachers] *first.*" That is, most of these teachers want to move from their current mechanical, teacher-centred use of the curriculum to the more learner-centred use intended. But in order to do so they need help. They need to see "*some changes made to the curriculum*."

The first thing some teachers would like to see changed is the format adopted for the SEMP curriculum, as these two teachers point out:

> *I guess what every one is trying to say is that the formant of the curriculum, not the actual content, the way it is laid out, that you are not sure if you are achieving your objective at the end of it*. (Teacher 4, Focus Group II)

> *Yes, I fully endorse what* [Teacher 4] *was saying because with objectives at the front and the activities at the back we tend to focus on the activities more. I find myself looking to see what I have to do …then saying 'look, I have some practical activities here!'* …[But this is] *after the fact, after you have finished teaching the topic*. (Teacher 3, Focus Group II)

The format, one teacher suggest, could be changed to the one currently being used to frame the primary science syllabus, with "*the content, structure, strategies, and assessment on the same page*."

Secondly, many teachers would also like to see some model lesson plans added to the curriculum document "*or even to the resource booklets that will in the future be accompanying the SEMP science curriculum document.*" Furthermore, a few teachers, like the one quoted below, need help in how to introduce and develop an engaging science lesson:

> Listen to what she said. She is right. In terms of teaching the objectives, we could have a set induction so we could know how we should be introducing the students to each objective and from that we could build the content. It would help us a lot if for each objectives we get that set induction. *(Teacher 1, Focus Group II)*

In essence, then, the teachers who participated in this study are crying out for help on how to use a curriculum document in planning and organizing for instruction (Quinn, Haggard, & Ford, 2006).

This is not entirely surprising given that many, if not most, of the science teachers who participated in the study have not yet had any formal pedagogical training, where they are exposed formally to curriculum theory and instructional design. One of the consequences of this deficiency in pedagogical training seems to be that many of them do not see the need for careful and complete reading of a science curriculum document. For example, most of the teachers who participated in the study did not become familiar with those parts of the science curriculum document that spelt out the philosophy, the aims, the goals, and the expected outcomes that the curriculum is trying to get students to achieve through their lower secondary school science experiences. Many of these teachers admitted that when they were using the SEMP curriculum document as a resource in their planning, they skipped the first two parts of the document and proceeded directly to the back of the document to the "*content and activity sections*."

Many of those teachers who approach the SEMP science curriculum in this back-to-front manner, said that "*it is the science content, and its related suggested activities, which is* [the engine that is driving] *my classroom curriculum use*," that is, how they plan, organize, and use the new science curriculum in their classroom teaching. Some of these teachers suggested that this invariably led to their "*planning being disjointed and short-term*," since they were planning without always having the "*big picture*" foremost in their minds.

This action also suggests that many of the teachers who participated in this study may have assumed that the new science curriculum's underlying philosophy is subject-centred (Zais, 1976) instead of the learner-centred curriculum that the curriculum designers are claiming the SEMP innovation to be (MOE, 2002, p. 13). Using the document in this "subject-centred" and fragmented manner is, in part, what is implied by the claim that many teachers selected for this study are using the SEMP science curriculum mechanically. Hence, if these teachers are to extend their levels of use of the SEMP science curriculum they will have to learn, among other things, how to utilize the document differently.

In addition to being facilitated in how to use the SEMP curriculum differently, many of the teachers interviewed are saying that they also need to be provided with an expanded inventory of pedagogical tools that would help to further empower them to make better decisions on how best to scope and sequence the proposed content topics in the curriculum. Specifically, these teachers are asking for further training in the type of pedagogy that would empower them to make better decisions about what science content they should include in the unit and lessons plans and which topics they should leave out. For example, the two teachers quoted below would like to be empowered in ways that would allow them to justify omitting those topics included in the syllabus that they consider are too difficult for high school students, since their inclusion not only "*frustrates*" both teachers and students, but also contribute to them not "*finishing*" the syllabus in a timely manner:

> *There are a couple of things in there that are too advanced for these kids. That is not required at this level. Some of the things you try to explain totally blow them off! For me…depending on the class I have…I totally dilute the content. That is why I don't ever* [get to] *finish the content*. (Teacher 4, Focus Group II)

> *I agree with what they are saying. Cells and Atoms and these kinds of things are out of space for them. They have no idea what you are saying to them…They don't understand what your are talking about because even those who try to learn it end up doing the wrong thing. At the end of it the teachers get frustrated and the students get frustrated.* (Teacher 8, Focus Group II)

These teachers clearly articulate the difficulties that many teachers operating at this level invariably have, that is, tremendous difficulties with consistently linking the science content of the curriculum innovation with its aims and goals. What these teachers are in fact saying here is that they need further training, including some basic training, that would orient them to the basic processes in science curriculum development and design.

This is an especially important request, since it suggests that the current SEMP training is not providing the teachers with all the critical skills they need to fully implement the new curriculum. The additional training they now need should further empower them by providing them with an added set of pedagogical tools that would better enable them to make the kinds of decisions needed to extend their level of use of the curriculum. If this new SEMP science curriculum innovation is to be fully explored and successfully implemented, the teachers implementing it will have to be able to decide for themselves, based on a sound analysis of their idiosyncratic classroom context, if a suggested science topic will or will not do the job of helping with the development of the type of critical competencies the curriculum is trying to foster in students. These include such competencies as problem-solving and communications skills, aesthetic expression, citizenship, personal development, and technological competence.

Furthermore, this training should ensure that teachers have the competence to be able to substitute more appropriate science topics for the ones they find inappropriate for their classroom contexts. Hence, customizing the pedagogical training opportunities for these, and possibly other, science teachers with these goals in mind would be one appropriate way forward.

Finally, these teachers made it clear that they would not only like to be provided with further specific training opportunities but would also like a "*proper*" re-orientation to the SEMP curriculum, with an emphasis on how the new SEMP curriculum expects them to deal with the challenges of those students with special needs, as the following two teachers underscore:

> *I feel that what everybody is saying has to do with teachers getting more training in how to deliver the topics.* (Teacher 5, Focus Group II)
>
> *Sometimes the kids we get they cannot read and write and sometimes you get a group of students and the syllabus would work and for others it just would not work. I don't know what adjustments can be made.… I don't know what can be put in place to make us* [teachers] *see what can be done*. (Teacher 6, Focus Group II)

At this stage in the implementation process of this science curriculum innovation, what other things, in addition to the training and the re-orientation of the teachers to the curriculum recommended by the teachers, can be put in place to "make [science teachers] see what can be done"? Probably the single most important "other thing" that should be done is to intensify the facilitation process. This would mean that the agency that is responsible for coordinating the implementation efforts needs to restructure the system that is now in place in these schools to provide support for the curriculum implementation processes.

One possible new structure would be one in which the heads of science departments, curriculum supervisors, and, to a lesser extent, school principals would become even more central to the implementation process. The justification for this new structure is that because the general affectivity levels and the behavioural characteristics of the mechanical user of any new innovation are unique, a unique kind of facilitator and facilitation is needed to help in moving the mechanical user of an innovation to higher levels of use (Hall & Hord, 2001). Hall and Hord describe what the ideal traits and tasks of such a facilitator might be. For example, such a facilitator "must be willing to do all sorts of seemingly low-level, nitty-gritty tasks to help teachers achieve short-term success in use" (p. 84). Furthermore, they must be willing to offer teachers short-term tips, must be prepared and capable of doing such things as "publish[ing] newsletters and establish[ing] telephone hotlines to answer mechanical questions as they arise" (p. 84). Hence, curriculum supervisors and science department heads will have to be re-oriented to take on these new roles if they are to become effective facilitators of the curriculum implementation process.

To be effective, these facilitators will have to help the teachers with many new tasks. For example, they will have to help the implementing teachers with finding and organizing the SEMP science materials for use, and with scheduling time to plan while they manage their classrooms and students. They will also have to model for the implementing teachers how to use the SEMP science materials effectively in the classroom. Furthermore, they will have to be prepared to co-plan with the implementing teacher, co-teach or demonstrate teaching in the implementing teacher's classroom, bring in substitute materials when glitches occur, and even be prepared to run and fetch what is needed should such occasions arise. Being prepared to become engaged in tasks such as these is what Hall and Hord (2001) mean when they say that the persons charged with facilitating the mechanical user of an innovation must be willing and able to do all sorts of "low-level, nitty-gritty tasks" (p. 84). Hence, another recommendation is that a structure of support be put in place that would involve facilitators with the kinds of traits described.

In conclusion, it is fair to say that these science teachers perceive the new science curriculum as being better suited to help to meet the national human development needs of the country than the old general science curriculum it replaced. However, most science teachers still have some concerns about the innovation. Seen through the CBAM lenses of stages of concern, the teachers' nine articulated concerns could best be characterized as being at the relatively high consequence levels of intensity. This means that, generally, these teachers have given considerable thought to the new initiative.

Though the teachers' reflections on the SEMP science curriculum innovation appear to be at a commendably high level, there does not appear to be a correspondingly high level of use of the innovation in their science classrooms. The level of use, at best, can be characterized as being mechanical. In mechanically using the curriculum in their classrooms, the teachers' efforts are mostly focused on short-term, day-to-day use, spending little time on connecting the individual daily science lessons to the "big science ideas" or on the long-term impact their teaching is having on students achieving the strategic aims, goals, and competencies the curriculum is endeavouring to engender in all students.

In conclusion, it must be noted that data from such a small sample (24 teachers) does limit the generalizability of these findings. Furthermore, due to the deficits in the scope of this research, which resulted in such a small sample size and other limitations that ensued, the findings have to be considered tentative. Substantial variability in the science teachers SoC and LoU remain unexplained by the current synthesis, indicating the need for further study. Despite this however, the study does suggest consistently that, at this stage of the implementation process, the following are needed to move the SEMP science curriculum innovation forward: more appropriate customized teacher training, a reorientation of the science teachers to the curriculum, and facilitation and support for the mechanical use-type teacher.

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