Caribbean Curriculum
Vol. 20, 2013, 101–113.

WHAT DO STUDENTS WANT IN THEIR SCIENCE TEACHERS AND THEIR SCIENCE LESSONS?

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Likert-type questionnaires were completed by 392, 15-year-old students from 13 schools across Trinidad and Tobago. Data gained from the questionnaires were used to report on those characteristics students deemed desirable in their science teachers. Students' views were sought on four key elements of good practice in science teaching: teachers' subject matter competence, teachers' pedagogical content knowledge, teachers' affectivity towards students, and the nature of science lessons taught by teachers. The data were analysed in the quantitative paradigm to yield response category sample percentages, which were used to make comparisons among the four target areas. The findings show that, for students, teachers' affectivity was the most important characteristic of a good science teacher. The second most favoured characteristic for students was teachers' pedagogical content knowledge, which was followed by teachers' subject matter knowledge.

Introduction

There is an implicit assumption that the ability to engage and motivate students is a characteristic of good practice in the teaching profession. Undoubtedly, students' engagement and interest in science has been a concern for researchers in the field of science education, and many seem to agree that there is a critical link between the role of the science teacher and students' levels of engagement and interest in science (Barmby, Kind, & Jones, 2008; Freeman, Anderman, & Jensen, 2007; Osborne and Dillon, 2008). While much is known about students' attitudes to science (Maharaj-Sharma, 2007; Nasr & Soltani, 2011), only very little is known about students' expectations of their science teachers and their science lessons. In this regard, therefore, much of the works cited in this paper draw on findings and experiences outside the Caribbean context, and it is important to note that these may not necessarily align with the views of Caribbean students. Furthermore, up to 2010, there was no mandatory pre-service teacher preparation programme for secondary school teachers in Trinidad and Tobago, so that most secondary school science teachers entered the profession with sound subject content background, training, and knowledge, but with minimal teacher preparation training.

In Trinidad and Tobago, secondary school students can be very critical about their teachers if they are unhappy with their classroom experiences, but they are far less vocal about positive classroom experiences. Because of this, it is unclear what Trinidad and Tobago students appreciate as desirable characteristics in those teachers who make their classrooms positive and enthusiastic learning environments. Also, in Trinidad and Tobago, there is a heavy emphasis on academic achievement and certification, to the extent that students do not necessarily take time to consider what characteristics they would attribute to good science teachers and good science teaching. Many high-performing students pass through the education system with the primary aim of scoring high on the final examination, regardless of how their teachers are able to get them to do so. Other students who are not motivated solely by this final outcome, and who might be a bit more concerned about how their science learning occurs, would often comment on the kinds of teaching experiences they have in the classroom, and to an equal extent comment on the traits of the science teachers who facilitate their science teaching and learning. These comments are however made in very private settings so that students' views about their "good" science teachers and, by extension, their good science teaching experiences are not well known in the local context.

Against this background, therefore, and in recognition of the fact that no study of this nature has been done in Trinidad and Tobago, the aim of this small-scale study was to solicit students' views and, more explicitly, to use their responses to identify elements of best practice in science education, as perceived by the students. This work seeks to reveal, firstly, what makes a good science teacher in the eyes of students and, secondly, to analyse, through their responses, their perceptions of the characteristics of good science lessons. In addition, this work will attempt to contrast the characteristics of science teachers and science lessons that reflect good practice and those that do not. It is hoped that this work will contribute to a deeper and more explicit explanation of what constitutes good practice from the students' perspective. In attempting to achieve this aim, the following two research questions will be addressed in this work:

1. *What, in students' views, are the characteristics of a good science teacher?*
2. *What, in students' views, are the characteristics of good science lessons?*

Literature Review

Wilson and Mant (2011), based on students' responses, have described exemplary teachers as those teachers who are clear explainers and whose lessons are characterized by high levels of thinking, problem solving, and discussion. Less teacher-led demonstrations and more practical work, as well as the delivery of contextualized science, are other qualities students agreed exemplary science teachers should possess (Thompson, Warren, Foy, & Dickerson, 2008). In other work by Tobin and Fraser (1990), Australian science students indicated that, in their view, exemplary science teachers are those who manage and facilitate student engagement, those who increase students' understanding of science, those who encourage students to participate in learning activities, and those who maintain a favourable learning environment in their classrooms. Subsequent to Tobin and Fraser (1990), Alsop, Bencze, and Pedretti (2005) explored exemplary science teaching through the eyes of science students, and found that students appreciate and respond positively to teachers who are truly knowledgeable about the science they are teaching and who use creative delivery methods to teach science content. In addition to making the subject matter appealing and the learning environment a positive one, students have also said that a good science teacher ought to make students feel important and valued, and through meaningful interactions good teachers should be caring, compassionate, understanding, and loving (Barmby et al., 2008; Parkinson, 2004).

In all these works, there is the implicit suggestion that the construct of the good science teacher, as perceived by students or otherwise, cannot be delinked from the aspect of good science teaching; again, perceived or otherwise. In fact, the literature continues to show that an essential element in any discussion about good science teaching and good science lessons is the good science teacher (Jenkins, 2006; Wilson & Mant, 2011). Detailed consideration and interpretation of the works of Parkinson (2004) and Barmby et al. (2008) is in congruence with reports from Kind (2009) and Gentry, Steenbergen, and Choi (2011), which seem to suggest that there are four broad traits that shape students' perceptions of what they attribute to the good science teacher: sound subject knowledge; strong pedagogical content knowledge and skills; high degree of nurturing; and relevant and contemporary lesson delivery skills and abilities.

Sparsely available anecdotal evidence, in the local context, seems to be somewhat aligned to these four broad traits, to the extent that on those occasions when students are vocal about their science teaching/learning

experiences, those that respond with positive comments often use words and phrases like "*fun lesson*," "*caring and kind*," "*miss knows a lot*," and "*fun activities*" to describe those teachers and those teaching/learning experiences with which they were highly pleased (Maharaj-Sharma, 2012b). The notion of *miss knows a lot* suggests sound subject matter knowledge, while phrases like *fun lessons* and *fun activities* suggest strong pedagogical content knowledge and the effective use of contemporary lesson delivery skills. The use of words like *caring* and *kind* by students to describe those teachers whom they are highly positive about is an indication of teachers' affectivity to students in these instances.

Methodology

Phase I – Interesting, Fun, and Enjoyable Science Classes

In the initial phase of this work, 22 schools were invited to participate (though only 13 were eventually selected for the substantive data collection in Phase II). All 22 schools agreed to participate, and a true/false response instrument was administered to a total of 504 Form 3 students from these schools. The aim was to determine, from among these 22 different classes, which classes students described as fun, interesting, and enjoyable. In this phase, students responded either *true* or *false* to the following three statements:

- My teacher makes my science class fun
- My teacher makes my science class interesting
- My teacher makes my science class enjoyable

The answers to these questions were analysed to identify those classes where students were highly positive and enthusiastic about their science learning experiences. From among the 22 classes, the highly positive and enthusiastic classes were determined based on more than 80% of the students in the class responding *true* to all three statements. Based on this criterion, 13 of the 22 classes were identified as positively engaging science classes. These 13 classes were selected for further data collection in Phase II of the work. The other nine classes were eliminated from the study beyond Phase I.

This phase was a validation measure for the data to be collected. Since the substantive data (Phase II) were to be used to extract qualities students identified as necessary in good science teachers and good science lessons, it was important to begin on the premise that students

believed, in the first instance, that the teachers (and lessons) about whom they were about to make comments were in fact exemplary in their view. This work did not seek to categorize the teachers and/or the lessons as good or not, but rather to gauge students' views about what are the qualities that made their science teachers and their science lessons good. In other words, the assumption was that, in students' views, the teachers and the lessons were good and the task was to find out from students what, in their views, made the teachers and the lessons good.

Phase II – What Made the Classes Positively Engaging?

Students from the 13 classes—a total of 392 students—were asked to complete a second questionnaire which consisted of 24 statements that addressed four target areas, with six questions in each target area. The target areas were as follows:

- Teachers' subject competence
- Teachers' pedagogical content competence
- Teachers' affectivity
- Nature of science lessons

The students responded to the questions in each of the target areas on a 5-point Likert scale to indicate that they either *strongly agreed*, *agreed*, were *neutral*, *disagreed* or *strongly disagreed* with each of the questions asked. The questionnaire was initially piloted with 44 Form 3 students, and the responses obtained from this pilot were studied for reliability and validity. Some questions on the original questionnaire had to be reworded to address issues of ambiguity that were obvious from the responses obtained in the pilot. The model used in the design of the questionnaire was similar to that used by Murphy and Beggs (2003), which was subsequently used in later work by Maharaj-Sharma (2012a). The completed questionnaires obtained from the 392 participants were analysed qualitatively to reveal students' views on the characteristics they felt were most important to them in their science teachers and their science lessons. All the questions on the questionnaire were skewed to positive responses, so that a response of *agree* or *strongly agree* for questions in any of the four target areas meant that students valued highly, as desirable characteristics in their science teachers, any one or more than one of the following: subject competence, pedagogical competence, affectivity, and highly positive and engaging lessons.

Phase III – Students' Views

To substantiate in a qualitative way, and to understand and delve deeper into exactly why students responded in the way that they did on the Likert questionnaire, one student from each of the 13 classes was selected and invited for a short interview. The selection was done by the class teacher and the only condition used to guide the selection was that the student had good oral and communication skills. The interview focused on two aspects of the students' responses from Phase II. Firstly, it sought to get students to explain in some detail the particular responses they gave on the Likert questionnaire and to elicit from them **why** they gave those responses. Secondly, students were asked to cite at least one example in each target area to support actions taken or displayed by their teachers that, in their view, constituted characteristics of a good science teacher and/or of good science teaching.

Results

Identification of the "Good" Science Teachers

Responses from all 392 students were suitable for analysis so that all the data collected in Phase II were used in the data analysis. The collated responses to questions in the first three target areas—subject matter competence, pedagogical content competence, and teachers' affectivity—were analysed to extract explicitly the extent to which these, in students' views, were desired characteristics of a good science teacher. What was noteworthy from the data collected from these questionnaires was that none of the students responded that they *disagreed* or *strongly disagreed* with any of the statements in these three target areas. In other words, their responses suggested that all the students were of the view that good science teachers ought to have sound subject competence, strong pedagogical content competence, and should exhibit high levels of affectivity in the science teaching/learning engagement. The interesting discrepancy, however, was in their detailed responses within each of the target areas and across the three target areas.

Target Area 1 – Subject matter competency

In respect of teachers' subject competence, 98% of the students *agreed* or *strongly agreed* that a good teacher should have sound subject matter competency, but the split among those who *agreed* and those who *strongly agreed* was 33% to 65% respectively. It meant, therefore, that while 65% of the students surveyed *agreed strongly* that subject matter competency was a highly desired characteristic of a good science

teacher, for 33% of the students this characteristic did not seem to be the most important. Interestingly, during the interview phase, 8 of the 13 students indicated that they had selected *strongly agree* in respect of this characteristic of a good science teacher, and when asked to explain further why they had responded in this way, they said that teachers' subject matter knowledge is "*very important*" to them, because they are interested in getting "*all*" the "*correct information*" to be able to "*do well*" on their examination. One student said that a good science teacher "*must know the science*" he or she is teaching and "*be able to explain it good for the students to understand it*." The other five students admitted that they expected that their teachers should "*know the science well*," but three of them suggested during the interview that in science it may not be possible to always know everything, and that even if there is some subject matter that the teacher does not know, he or she should be "*willing to research and find out about it to share it with students*." Two students mentioned the phrase "*lifelong learning*" and said that they felt that "*teachers should always be reading up about new things in science,*" and that teachers should "*share the new things with the students*." When probed further, though, they both agreed that only "*few*" science teachers "*seem*" to be "*lifelong learners*."

Target Area 2 – Pedagogical content knowledge

Analysis of responses to questions in the pedagogical content knowledge target area revealed that 94% of the students *strongly agreed* that this was a necessary characteristic of a good science teacher, while 6% of the students *agreed* that it was. None of the students responded *undecided* to questions in this target area. This suggests clearly that students value highly the process of learning—how their teachers facilitate the learning process in the classroom—as an important characteristic of the good science teacher. In the interview phase, students described their most memorable learning experiences—their good science lessons—as those in which they were engaged in "*exciting hands-on activities and in doing experiments*." They also spoke of taking part in "*role play and drama to learn about electricity flow and about energy*" and said that the "*good science lessons*" were the ones in which their teachers allowed them "*to act out the science*." The students indicated that when whole group discussions were used in the classroom, if their teachers provided opportunities for "*everyone to participate and to let everyone say something,*" and if their teachers made everyone feel that their "*ideas are important,*" that those lessons were "*good science lessons*." When compared to the responses students gave about Target Area 1 – subject matter competency, the data indicate that students are saying that *how*

their teachers facilitate learning is more important to them than *what* their teachers teach to them. In other words, students are saying that the good science teacher ought to be better at teaching the topic than knowing about the topic. From among those students interviewed, there was complete agreement that when learning is "*exciting and interesting*" and when, as students, they are "*engaged*" and "*allowed to speak*" in science lessons that they "*understand the science*" and they "*remember what was taught*." Two of the students indicated in the interview that when their science learning experience is fun, interesting, and exciting, that they always "*want to learn more science*." Responses like these are suggestive of two main things:

1. Teachers' effective use of contemporary (non-traditional) teaching/learning strategies to make science learning appealing and engaging for students
2. Students' appreciation of their teachers' efforts to make their science learning experiences pleasant and memorable

Both of these speak to a high degree of pedagogical content knowledge on the part of the teacher and, through their responses, students have indicated that this is a highly desirable characteristic of the good science teacher.

Target Area 3 – Teachers' affectivity

In Target Area 3 – teachers' affectivity, the combined responses to questions in this section of the Likert questionnaires show that an overwhelming 98% of the students responded *strongly agreed* when asked to comment on teachers' demonstration of caring, compassion, and affection to them. Their responses indicated quite convincingly that, in their view, teachers' affectivity was a necessary characteristic of any good science teacher. The high statistic in this target area suggests that even though students regard sound subject matter knowledge and sound pedagogical content knowledge as essential features of the good science teacher, that a critically important and highly valued characteristic for them is the human aspect involved in teaching. This was made abundantly clear during the interview phase in which all the students interviewed said that a "*good science teacher*" should "*show understanding towards the students*," and that they "*should care when students have problems*" and be "*willing to listen to the students and to help them if they can*." Students also said that they felt that a good science teacher should also be willing to "*give advice to any student who needs it*." One student spoke about a good science teacher being "*warm*"

and "*easy to approach*," and that "*miss should be helpful and kind ……willing to listen*…." Another student spoke about the good teacher being "*like a good parent……always giving and forgiving…..without wanting back*….." Expectations of nurturing captured in responses such as these given by the students during the interviews were widespread and were articulated many times with reverence and passion by the students. It came across as something that the students viewed as sacred to the construct of a good teacher. Even though it was obvious from their Likert responses that students valued most highly teachers' affectivity as the most important characteristic of a good teacher, it was their interview responses that provided a real sense of how important this nurturing characteristic was to them, and how much more important to them it was when matched against their teachers' subject and pedagogical competencies.

Good Science Teacher and Good Science Teaching

Target Areas 1, 2, and 3

Students have clearly identified subject knowledge competence and pedagogical content competence as essential and highly desirable characteristics of the good science teacher, but far more important than both of these for almost all the students in this work was their teachers' affectivity towards them. They have hinted further that a good science teacher will enact good science teaching by demonstrating these desired qualities in their everyday practice and they have, through their responses, assigned an implicit rating to the desired qualities of a good science teacher. Their responses show that good science lessons delivered by good science teachers—those that students look forward to—are characterized by:

- high levels of teacher's affectivity (98% of the students *strongly agreed*);
- sound pedagogical content knowledge of the teacher (94% of the students *strongly agreed*); and
- solid subject matter knowledge of the teacher (65% of the students *strongly agreed*).

Target Area 4 – Characteristics of good science lessons

In analysing students' Likert responses in Target Area 4, it was found that, as with good science teachers and good science teaching, students highlighted specific characteristics about the science lessons that, in their views, were "*good science lessons*." Almost unanimously, students said that those lessons in which they were allowed to "*do experiments*" were

the "*best*" science lessons. In exploring this view further, the students who were interviewed were asked to explain about this dominant view among their colleagues. The responses given by all the students were very similar and could be captured in the following response from one student: "*when I do the experiments….I understand the science better*" because "*I can see exactly what happens*." During the interviews, students also spoke about learning through collaboration and information sharing, as many of those interviewed said that they "*enjoyed learning from their friends*" when they did practical activities "*in groups*."

The use of drama in science teaching was another thing that the students said they appreciated highly. Ten of the 13 students interviewed indicated that when "*drama*" was used to develop concepts they "*understand the topic*" better. Two examples that were cited by the students was the dramatization of how "*germination occurs*" and how the "*amoeba moves*." When asked to explain further how the drama helped them to understand the ideas, the interviewed students said that the dramatization allowed them to "*visualize*" and hence "*remember*" the processes.

In additional responses to questions in Target Area 4, students also indicated that they appreciated the use of models, role play, and calypso when these are used to teach science. Data gathered from the interviews in respect of these approaches indicated that students were resentful of science lessons that involved large quantities of "*textbook reading and note taking*," and that they preferred science learning that involved them having "*fun*," and which provided them with opportunity to "*do things*" and "*to create things*" and "*to present work*" to their peers. They also had very positive views about those lessons that involved the use of media and other forms of information and communication technologies (ICTs). The interviewed students spoke specifically about the usefulness of "*video clips*" and "*computer simulations*" in helping them to "*visualize processes, designs and events*." A noteworthy comment that two students made during the interview phase was that the use of ICTs "*left lasting impressions*" in their "*minds*," which they further explained "*helped*" them "*to remember the topics….even for the examination*." In summarizing, therefore, the students were clear that good science lessons are characterized by the effective use and infusion of the following approaches and strategies during science teaching and learning:

- Experiments/practical work
- Drama
- Models, role play, and song
- ICT integration

Discussion

Teachers' implicit role as nurturers, caregivers, and helpers has historically been assumed and expected, particularly from the students' perspective. This work shows that even today, students expect their teachers, and in this specific case their science teachers, to be more than just information providers and learning facilitators. Marzano (2007) speaks of students' rejection of science teachers whose subject matter knowledge and whose pedagogical content knowledge are sound and contemporary, but whose interactions with students are cold, distant, and rigid. The data reported in this article show that students in Trinidad and Tobago are not much different in terms of what they expect of a good science teacher. It was shown that even though 65% of the students in this small-scale study are of the view that subject knowledge is an important characteristic of a good science teacher, an overwhelming 98% of them indicated unambiguously that teachers' affectivity is a more desirable characteristic for them. But even with this strong emphasis on the quality of exemplary science teachers to make them feel cared for, appreciated, and comfortable, it is clear that the students do not undervalue the quality of sound pedagogical content competency of their science teachers—94% of the students indicated that sound pedagogical content knowledge and competency was a very important characteristic of the good science teacher they described. While the general findings of this work are new for the Trinidad and Tobago context, the specific ranking of the qualities students deem desirable in a good science teacher is new for research in this area. This is so because even though Freeman et al. (2007), as well as Wilson and Mant (2011), have reported that teachers' ability to motivate, engage, and interest students in science learning are characteristics of exemplary science teachers, their works and other works in this area have not *ranked* in any specific way these desirable characteristics.

The ranking of teachers' affectivity as the characteristic most desired by students in a good science teacher was particularly surprising, especially since some other works have reported that subject matter knowledge and pedagogical content knowledge are the hallmarks of good teachers (Barmby et al., 2008). In that context, therefore, there seems to be the implicit suggestion that from the perspective of the students in Trinidad and Tobago, high levels of teacher affectivity distinguish a good science teacher from one that is not—assuming that teachers' subject matter knowledge and pedagogical content knowledge are both sound.

In respect of what students considered to be a good science lesson, through their responses, students in this work echoed views similar to those in works by Parkinson (2004) and Alsop et al. (2005), which were that that the effective use of practical activities, experimentation, and other contemporary teaching/learning strategies such as drama and role play to deliver science instruction makes good science lessons. Given the influence that media and technology now have on students globally, it was not surprising that students in Trinidad and Tobago indicated convincingly that they too appreciated the meaningful use of ICTs in their lessons, and cited specifically the visual and graphical impact that ICT integration adds to science conceptualization and to the making of good science lessons.

It is clear from this work that, from the students' perspective, the construct of a good science teacher is intricately linked to good science teaching and good science lessons. Science teachers, no doubt, have great influence and control over students' enjoyment, interest, engagement, participation, and levels of comfort in science learning. The implicit message emanating from this work seems to be that the good science teacher, through good science teaching, can transform any science class into a good science class. More explicitly, however, students have responded to indicate that they value most the warmth of student-teacher interactions in their classroom encounters and the comfort of knowing that their science teachers care about them. In that context, therefore, it would be especially important for science teachers to remember that while their students look up to them as subject matter experts who are expected to make their science learning experiences fun, enjoyable, and interesting, their students expect also, almost unanimously, that their teachers would make their science learning a human enterprise filled with warmth, care, and love.

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