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ST. AUGUSTINE

Lower Secondary Science Teaching and Learning

Teachers' Characteristics and Perspectives

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December 2003

The ideas and opinions expressed in this work are those of the author and do not necessarily represent the views of the School of Education.

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PREFACE

This study was part of the research project, *Lower Secondary Science Teaching and Learning*, which was conducted by the School of Education, The University of the West Indies (UWI), St. Augustine. The overall goal of the research project was to determine the status of the teaching and learning of science at the lower secondary level in Trinidad and Tobago. This component looked at some of the characteristics and perspectives of lower secondary science teachers. Other components examined practices in the lower secondary science classroom and the availability of materials and equipment for teaching lower secondary science.

ACKNOWLEDGEMENTS

The cooperation of the principals and lower secondary science teachers of the schools that participated in this study is gratefully acknowledged.

Other components of this research project were conducted by Dr. Susan Herbert, Mrs. Joycelyn Rampersad, and Dr. Rawatee Maharaj-Sharma of the School of Education, UWI, St. Augustine, and Prof. Christopher Akinmade, a visiting scholar from the University of Jos, Nigeria. The contributions of these researchers in critiquing the questionnaire for this component of the project, and in helping with the collection of data are also gratefully acknowledged.

The entire research team is grateful for the funding for the overall project, which was provided by the Campus Research and Publications Fund Committee of the St. Augustine Campus of UWI.

LIST OF ACRONYMS AND ABBREVIATIONS

ASETT	Association for Science Education of Trinidad and Tobago
CIE	University of Cambridge International Examinations
CXC	Caribbean Examinations Council
Dip.Ed.	Diploma in Education
GCE	General Certificate of Education
NCSE	National Certificate of Secondary Education
SEMP	Secondary Education Modernisation Programme
UWI	The University of the West Indies

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CHAPTER 1

Background to the Study

1.1. Introduction

This study, which was conducted during 2002, was designed to gain a fuller understanding of the characteristics of the teachers engaged in teaching science at the lower secondary level in schools in Trinidad and Tobago, as well as some of the perspectives of these teachers with respect to the teaching of lower secondary science. It follows a study with somewhat similar aims that was carried out in 1994 (see George, 1995). This present study also sought to determine what gains, if any, had been made in the intervening 8-year period since 1994, with respect to the quality of the provision for the teaching and learning of science at this level.

The study done in 1994 showed that the lower secondary science teachers were well qualified academically, with more than 79% possessing at least a B.Sc. degree. However, less than 50% of the teachers had been trained professionally. The balance between female and male teachers was approximately 1.3:1. There was a much higher percentage of science teachers of East Indian descent over science teachers of African descent (53.9% to 26.0%) than one would predict from population demographics which portray an almost even distribution between these two groups. The current study also sought to examine these teacher characteristics, and to determine whether there had been any changes over time.

The science curriculum at the upper secondary level in schools in Trinidad and Tobago is primarily shaped by the syllabuses of the Caribbean Examinations Council (CXC) and the General Certificate of Education (GCE) administered by the University of Cambridge International Examinations (CIE). The 1994 study showed that the situation at the lower secondary level was very fluid in that there were numerous ways in which teachers went about devising the science curriculum at this level. In the recent past, there have been two lower secondary science curriculum initiatives, namely, the National Certificate of Secondary Education (NCSE) revised draft science syllabus (Trinidad and Tobago. Ministry of Education, 1995), and the Secondary Education Modernisation Programme (SEMP) science syllabus (Trinidad and Tobago. Ministry of Education, 2002), both prepared by the Ministry of Education. The SEMP science syllabus was of particular interest in this study, given that it was the latest lower secondary science curriculum effort by the Ministry of Education, and was being piloted in a few schools. This study sought to determine whether the new SEMP materials were serving to remove some of the variance in the lower secondary science curriculum that was detected in the 1994 study.

Teachers were not at all satisfied with the physical facilities and the educational resources available for teaching lower secondary science in 1994. They were also not satisfied with the level of support they received for teaching science from significant stakeholders outside of their own school settings. The quality of physical facilities and other provisions for science teaching was also examined in the present study.

The frequency and form of practical laboratory work were also investigated. Practical laboratory work for students is still viewed as a hallmark of good science teaching. Furthermore, it is felt that students' learning of science is likely to be enhanced if they engage in practical, student-generated problem-solving activities. In 1994, teachers reported that they did practical laboratory work with their students on a fairly regular basis but that this consisted mainly of teacher demonstrations. This present study continued to examine this issue.

1.2. Research Questions

Against this backdrop, then, the following research questions were pursued:

1. What are the characteristics and qualifications of science teachers at the lower secondary level of the public secondary schools in Trinidad and Tobago?
2. What science subjects are taught at this level?
3. What is the source of the lower secondary science curriculum?
4. What are the science texts in use?
5. How much time is allocated to the teaching of lower secondary science?
6. What additional skills do lower secondary science teachers perceive that they need to teach science effectively?
7. How do lower secondary science teachers rate the support that they receive for teaching science from significant stakeholders?
8. How frequently is practical laboratory work done?
9. What type of practical laboratory work is done?
10. How do lower secondary science teachers rate the physical facilities available for teaching science?
11. How do lower secondary science teachers rate the educational resources available for teaching science?
12. What changes, if any, have occurred in the provisions for, and execution of the teaching of lower secondary science between 1994 and the present time?

CHAPTER 2

Methodology

2.1. The Instrument

The survey questionnaire technique was used for the collection of data. The instrument used was a modification of the questionnaire used in 1994. The modifications were made in an effort to shorten the questionnaire, with the hope that the response rate from teachers would be greater on a shorter questionnaire. These modifications were the subject of peer review. The reviewers were the four researchers working on other components of the research project, and two science curriculum officers from the Ministry of Education. The final version of the questionnaire used is shown in Appendix A.

2.2. The Sample

The decision was taken to target all 115 government and government-assisted secondary schools with a lower secondary sector existing at the time of research. As was the case in the 1994 study, it was estimated that most schools would have three or four teachers teaching science at the lower secondary level, except for the double-shift junior secondary schools, which would have six teachers. Consequently, six questionnaires were sent to all junior secondary schools with a double shift, and four questionnaires were sent to all of the other schools. A covering letter was sent to the principal of each school detailing the purpose of the questionnaire and seeking his/her cooperation.

2.3. The Response

The questionnaires were sent out in February 2002. By May 2002, only 53 schools had responded. A reminder was then sent to principals of defaulting schools, and this was followed by numerous telephone calls, in an attempt to secure the completed questionnaires. Data collection was terminated in January 2003, at which time, 71 of the 115 schools (61.7%) had responded. This yield was significantly lower than the yield of 89.0% obtained in the 1994 study.

In all, 224 completed questionnaires were received. Table 2.1 shows the origin of the completed questionnaires by school type, and Table 2.2 shows the data by educational division.

Table 2.1. Frequency of Response of Teachers by School Type

School type	Number of schools with lower secondary sector	Number of schools responding	% of schools responding	Number of teachers responding	Average no. of teachers per school responding
Junior secondary	19	12	63.1	57	4.8
5-yr Government/ Composite	39	23	59.0	56	2.4
5-yr Government-assisted	7	6	85.7	10	1.7
7-yr Government	21	11	52.4	38	3.5
7-yr Government-assisted	29	19	65.5	63	3.3
TOTAL	**115**	**71**	**61.7**	**224**	**3.2**

Table 2.2. Frequency of Response of Schools and Teachers by Educational Division

Educational division	Number of schools with lower secondary sector	Number of schools responding	% of schools responding	Number of teachers responding	Average number of teachers per school responding
St. George West	31	14	45.2	48	3.4
St. George East	15	11	73.3	36	3.3
St. Andrew/ St. David	9	6	66.7	11	1.8
Caroni	11	7	63.6	20	2.9
Nariva/Mayaro	4	1	25.0	3	3.0
Victoria	25	15	60.0	53	3.5
St. Patrick	13	12	92.3	41	3.4
Tobago	7	5	71.4	12	2.4
TOTAL	**115**	**71**	**58.7**	**224**	**3.1**

Overall, the rate of return was best from the 5-year government-assisted schools (though small in number), and the 7-year government-assisted schools. The rate of return was also good in St. Patrick, St George East, and Tobago. Participation was lowest in the 7-year government schools and in Nariva/Mayaro, Caroni, and St. George West. Although the overall response rate for this study was lower than in 1994 (in spite of the use of a shorter questionnaire), this response rate and the spread of responses were considered to be adequate for the purposes of this study.

CHAPTER 3

Findings

3.1. Introduction

The findings of the research are organized around the various research questions. Graphical representations of data are presented within the main body of the report, while tables with detailed statistics are presented in Appendix B.

3.2. Research Question #1

What are the characteristics and qualifications of science teachers at the lower secondary level of the public secondary schools in Trinidad and Tobago?

3.2.1. Gender distribution of teachers

There was a preponderance of female lower secondary science teachers responding to the questionnaire. There were 141 female teachers (62.9%) and 81 male teachers (36.2%) in the sample (see Table B1).

3.2.2. Age distribution of teachers

There were 8 teachers (3.6%) who were less than 21 years of age. Seventy-five of the teachers responding (33.5%) were in the 21-30 age range, while a further 70 teachers (31.3%) were in the 31-40 range. This means that approximately 68% of the science teachers responding were 40 years of age or younger (see Figure 3.1 and Table B2).

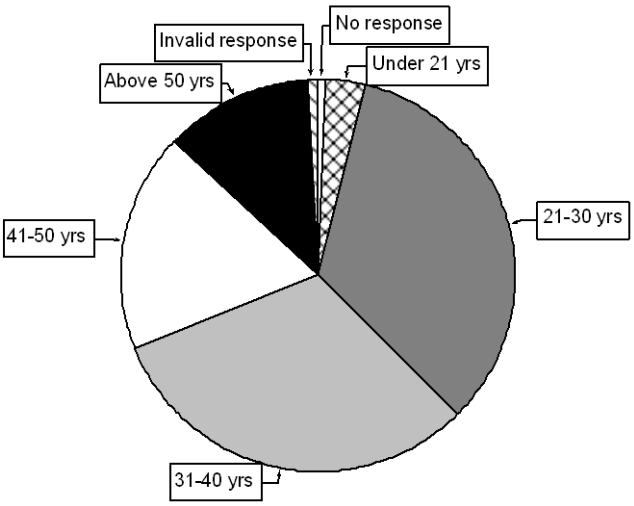

Figure 3.1. Age distribution of teachers.

3.2.3. Ethnicity of teachers

One hundred and forty-four teachers (64.3%) described themselves as being of East Indian descent, while 47 (21.0%) described themselves as being of African descent. A further 24 teachers (10.7%) indicated that they were from a mixed ethnic background (see Figure 3.2 and Table B3).

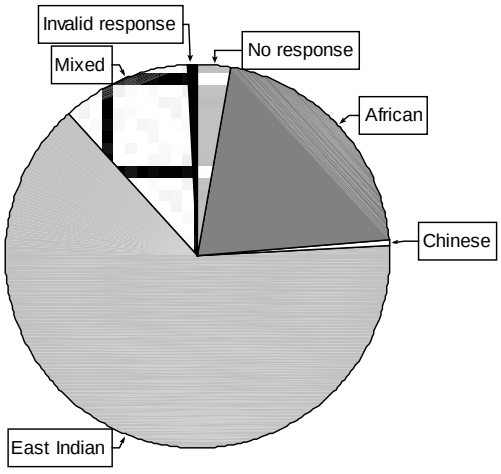

Figure 3.2. Distribution of teachers by ethnicity

3.2.4. Secondary school types attended by teachers

More than half of the teachers (123 or 54.9%) indicated that they had attended 7-year government-assisted secondary schools. Thirty teachers (13.4%) had attended 7-year government secondary schools. The remainder of the teachers had attended a variety of school types and combinations of school types. Included among these were 15 teachers (6.7%) who reported that they had begun their secondary schooling in junior secondary schools (see Figure 3.3 and Table B4).

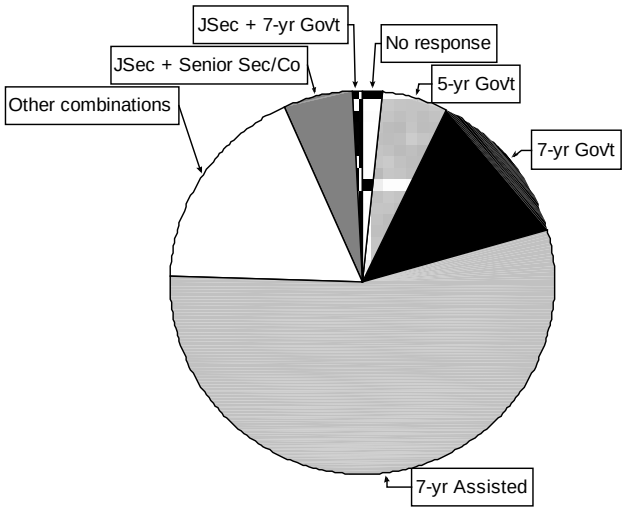

Figure 3.3 Distribution of teachers by school types attended

3.2.5. Academic qualifications and school type

Of the 224 science teachers in the sample, 44 (19.6%) held A-level or equivalent qualifications, such as associate degrees or diplomas. The vast majority of teachers (164 or 73.2%) held a bachelor's degree. Of these, 161 held B.Sc. degrees. The remaining 3 teachers held a B.Ed. degree with biological sciences, a B.A. degree with a major in biology, and a biomedical engineering degree, respectively. A few teachers (12 or 5.4%) held master's degrees (see Figure 3.4 and Table B5).

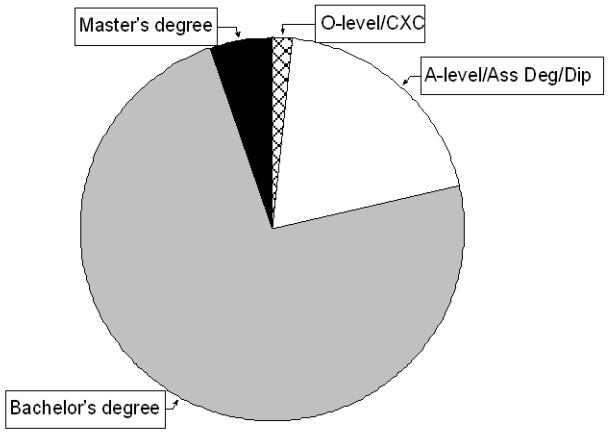

Figure 3.4 Distribution of teachers' academic qualifications

The junior secondary schools had the lowest percentage of staff with at least a bachelor's degree (66.7%), while the 5-year government-assisted, 7-year government, and 7-year government-assisted schools had more than 80% of their science teachers with this level of qualification (see Table B6).

3.2.6. Professional qualifications and school type

Just over 37% of the science teachers in the sample reported that they had no professional qualifications (see Figure 3.5 and Table B7). A further 63 teachers (28.1%) indicated that their professional training took the form of "other" activities such as workshops and other short-term professional activities mounted by CXC and the Ministry of Education. There were only 62 teachers (27.7%) who possessed the Diploma in Education (Dip.Ed.), which is geared specifically to meet the needs of secondary school teachers. A further 4 teachers (1.8%) indicated that they had gone the additional step and had acquired an M.Ed. degree.

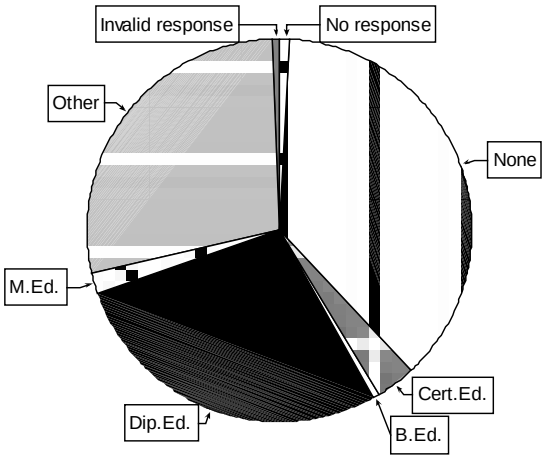

Figure 3.5. Distribution of teachers' professional qualifications

The relatively high percentage of untrained science teachers exists in practically all school types (see Table B8). More than half of the teachers in all school types had either had no professional training or else their professional training was limited to participation in workshops.

3.2.7. Area of specialization

In the main, teachers reported that they had specialized in biology/zoology/botany (43 or 19.2%) or chemistry (37 or 16.5%), or in a combination of chemistry and the biological sciences (54 or 24.1%). Only 18 teachers (8.0%) reported that they had specialized in physics (see Table B9).

3.3. Research Question #2

What science subjects are taught at this level?

3.3.1. Form 1

Teachers in all the junior secondary, 5-year government/composite, and 5-year government-assisted schools reported that they teach "integrated science," "science," or "general science" in Form 1. Teachers in 9 of the 11 7-year government secondary schools (81.8%) and 17 of the 19 7-year government-assisted schools (89.5%) also said that these subjects were taught at this level. It is instructive that teachers in the same school did not always use the same term to describe the science being taught. Teachers in the 4 schools that did not offer integrated science/science/general science indicated that they taught the separate sciences from Form 1.

3.3.2. Form 2

The pattern described for Form 1 was repeated in Form 2, except that one junior secondary school switched from teaching integrated science/science/general science in Form 1 to teaching the separate sciences in Form 2.

3.3.3. Form 3

With the exception of the junior secondary schools, all schools that had Form 3 classes offered the separate sciences in Form 3. In some instances, integrated science was also offered at the Form 3 level in these schools. Eleven of the 12 junior secondary schools (91.7%) continued to offer integrated science/science/general science only, and the 12th school continued to offer the separate sciences, as it had done in Form 2.

3.4. Research Question #3

What is the source of the lower secondary science curriculum?

Reports indicated that the science curriculum in these schools was derived from a variety of sources.

3.4.1. Form 1

Thirty-eight of the 52 teachers who did not respond to this item did not teach Form 1.

There were 8 schools in the sample that were SEMP pilot schools. Teachers in all 8 schools indicated that they were indeed using the SEMP syllabus as the base for their curriculum. Some teachers in other schools also used the SEMP syllabus. Forty teachers (17.9%) indicated that the source of their curriculum was the text and two or more of the official syllabuses available—the SEMP, NCSE, and CXC syllabuses. Twenty-seven teachers (12.1%) indicated that the SEMP or NCSE syllabus documents were used as the

curriculum. Twenty-two teachers (9.8%) said that a curriculum designed in the school was used along with the text, and a further 20 teachers (8.9%) said that only the text was used. A large number of "other" curriculum sources were mentioned by the remaining teachers. These included various combinations of sources. The use of a text featured prominently in many of these combinations (see Figure 3.6 and Table B10).

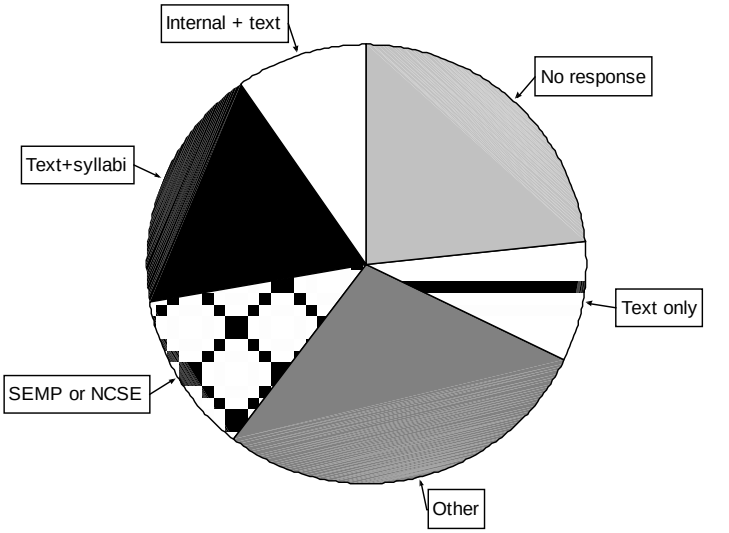

Figure 3.6. Distribution of sources of Form 1 curriculum

3.4.2. Form 2

The situation with respect to the science curriculum in Form 2 was very similar to that in Form 1, as can be seen in Figure 3.7 and Table B11. Again, a large number of the teachers who did not respond to this item (40 out of 54) did not teach Form 2 science.

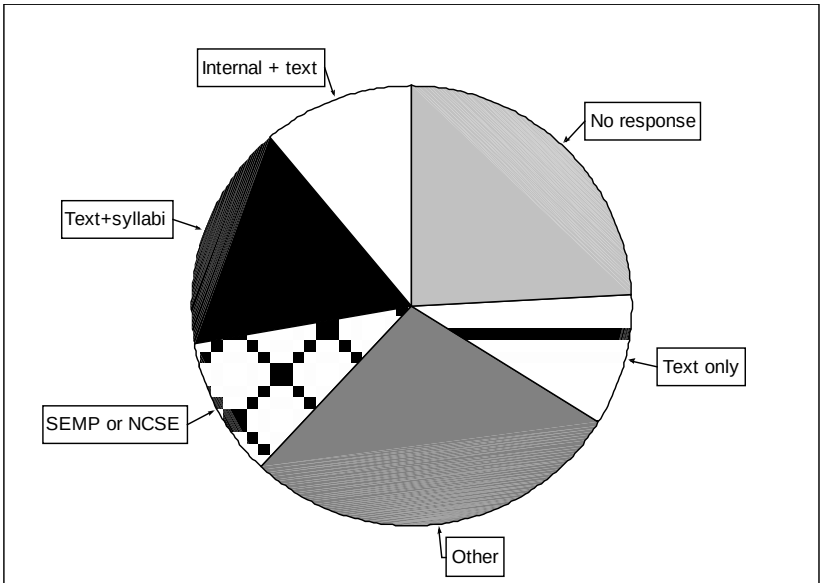

Figure 3.7. Distribution of sources of Form 2 curriculum

3.4.3. Form 3

The situation changed drastically in Form 3. Some schools that were not SEMP pilot schools continued to draw on the SEMP syllabus. Thirty teachers (13.4%) stated that they used a text along with two or more of the SEMP/NCSE/CXC syllabuses, while 29 teachers (12.9%) said that they used the CXC syllabuses only. Fifteen teachers (6.9%) reported that they used the SEMP or NCSE syllabus, while another 15 (6.9%) indicated that they used a text with the CXC syllabuses. The remaining teachers (comprising nearly 60% of the sample) said that they used various other combinations of sources for their curriculum.

3.5. Research Question #4

What are the science texts in use?
(The analysis of science texts in use was done by school.)

3.5.1. Form 1

The text, *New Lower Secondary Science*, *Book 1*, by Tho Lai Hoong and Ho Peck Leng was used by 38 of the 71 schools (53.5%). Fifteen schools (21.1%) used the text, *New Integrated Science for the Caribbean*, *Book 1*, by L. Durgadeen, V. McClenan, S. West, and E. Williams. A few other texts were in use by the remaining schools.

Eight of the 12 junior secondary schools (66.7%) used the Hoong and Leng text, and it was also used by 10 of the nineteen 7-year government-assisted schools (52.6%) (see Table B12). Two 7-year government and two 7-year government-assisted schools used separate science texts in Form 1.

3.5.2. Form 2

Texts by Hoong and Leng were the most popular at the Form 2 level. They were used by 32 schools (45.1%) in Form 2. A few of these schools used *New Lower Secondary Science, Book 1* only, while the others used either *New Lower Secondary Science, Book 2,* or a combination of both books. These texts by Hoong and Leng were used by the majority of junior secondary schools (8 out of 12, or 66.7%), and least of all by the 7-year government-assisted schools (6 out of 19, or 31.6%).

Twelve schools (16.9%) used *New Integrated Science for the Caribbean, Book 2,* by L. Durgadeen, V. McClenan, S. West, and E. Williams, while 2 schools continued to use *Book 1*.

Other books used included *Integrated Science for Caribbean Schools* (*Books 1 & 2*) by F. Commissiong, F. Dalgety, and N. Lambert. Seven of the schools used separate science texts in Form 2. These consisted of three 7-year government schools and four 7-year government-assisted schools, and included those that had used separate science texts in Form 1 (see Table B13).

3.5.3. Form 3

The 8 junior secondary schools that used the Hoong and Leng texts in Forms 1-2 continued to use them in Form 3. *Book 2* was the most commonly used text in Form 3, but a few schools continued to use *Book 1* at this level.

The pattern of text use changed drastically in the other school types in Form 3. Twenty different texts (or combinations of texts) were reported to be in use in the 5-year government/composite schools, 18 in the 7-year government schools, and 23 in the 7-year government-assisted schools. Nearly all of these texts were biology, chemistry, or physics texts.

3.6. Research Question #5

How much time is allocated to the teaching of lower secondary science?

The data presented by the teachers were to some extent unreliable since, within a given school, teachers sometimes reported different numbers of periods of science teaching per week and/or different lengths of a class period. However, it was still possible to deduce the following overall trends:

- A few schools (of various types) have 105-120 minutes of science per week
- Nearly all junior secondary schools have 135 minutes of science per week
- The weekly allocation for science in most of the other schools ranges from 160 minutes to 200 minutes

3.7. Research Question #6

What additional skills do lower secondary science teachers perceive that they need to teach science more effectively?

Sixty-five teachers (29.0%) did not identify any additional skills needed in order to teach lower secondary science better. The need for enhanced pedagogical skills was mentioned by 41 teachers (18.3%) and a further 35 teachers (15.6%) indicated that they needed to develop better classroom and laboratory management skills. A variety of skills was mentioned by the remaining teachers, including skills in the use of computers and audio-visual equipment (18 or 8.0%), and skill in dealing with slow learners and children with disabilities (17 or 7.6%).

3.8. Research Question #7

How do lower secondary science teachers rate the support that they receive for teaching science from significant stakeholders?

Over 90% of the responding teachers rated the support that they received from their schools in the teaching of lower secondary science as "satisfactory" or better. However, they were not as pleased with the support given by other significant stakeholders in the education system. In particular, they rated the support given by the Association for Science Education of Trinidad and Tobago (ASETT) and by UWI as "poor." There were mixed reactions to the support provided by the Ministry of Education. Seventy-three teachers (32.6%) said that the support was "satisfactory," but 105 (46.9%) said that it was "poor" (see Figure 3.8 and Table B14).

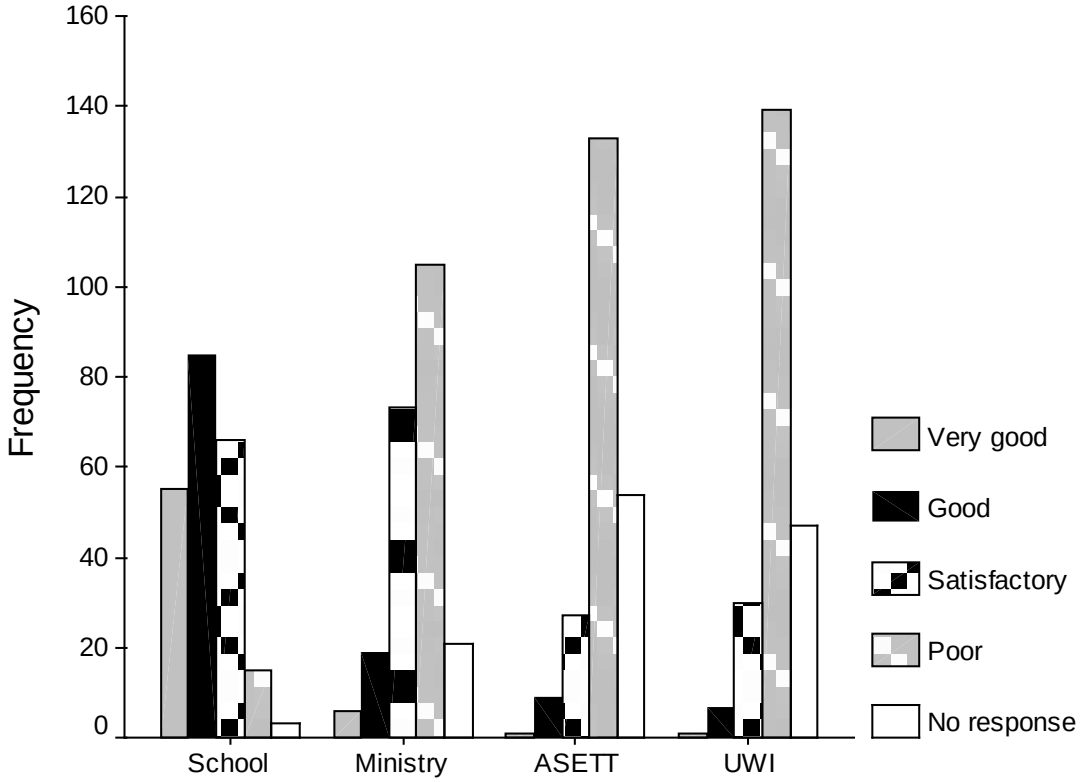

Figure 3.8. Rating of support for teaching science

3.9. Research Questions #8 and #9

How frequently is practical laboratory work done?
What type of practical laboratory work is done?

Of the 169 Form 1 teachers responding to this item, 28 (16.6%) indicated that they did practical laboratory work with their science classes every week and 43 (25.4%) said that they did it every two weeks. The frequency of reported practical laboratory work decreased in Form 2 and Form 3. Twenty-six of the 170 Form 2 teachers responding (15.3%) reported that laboratory work was done every week, while 40 (23.5%) reported a frequency of every two weeks. Among the 167 Form 3 teachers, only 19 (11.4%) reported weekly laboratory work, and 29 (17.4%) reported fortnightly sessions (see Figure 3.9). Teachers in all of the SEMP schools in the sample reported that they hardly ever did practical laboratory work with their students.

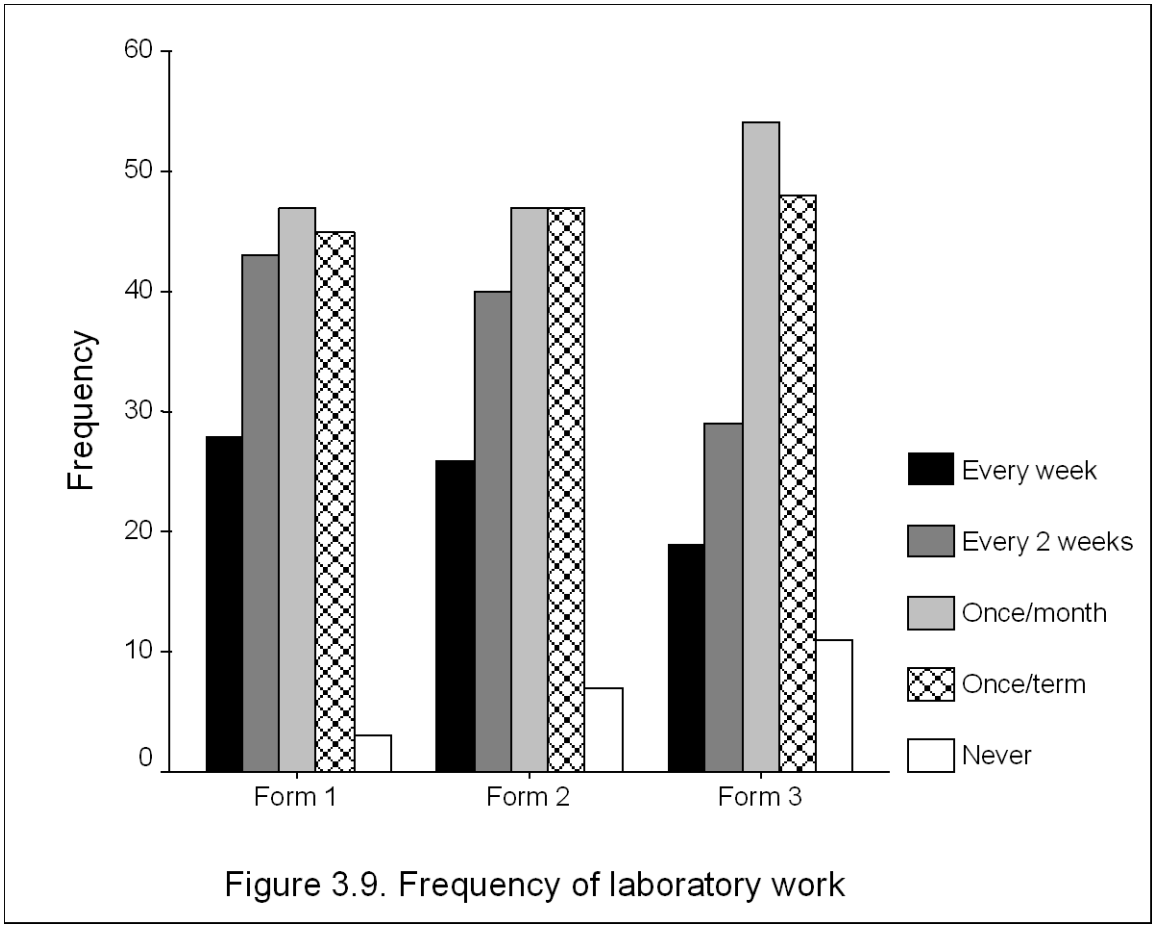

Figure 3.9. Frequency of laboratory work

Practical laboratory work was reported to be done most regularly in the junior secondary schools at all three form levels.

Teachers said that they engaged in teacher-generated, problem-solving practical activities on a fairly regular basis. A combined total of 152 teachers (67.9%) said that they performed such problem-solving activities at least once per month, with 51 of them (22.8%) stating that they did them weekly. Teacher demonstrations were also reported as being done at least once per month by 152 teachers (67.9%), but a smaller number (28 or 12.5%) claimed that they did such demonstrations weekly. Less prevalent were practical activities for developing skill in handling apparatus, and student-generated, problem-solving practical activities (see Figure 3.10 and Table B15).

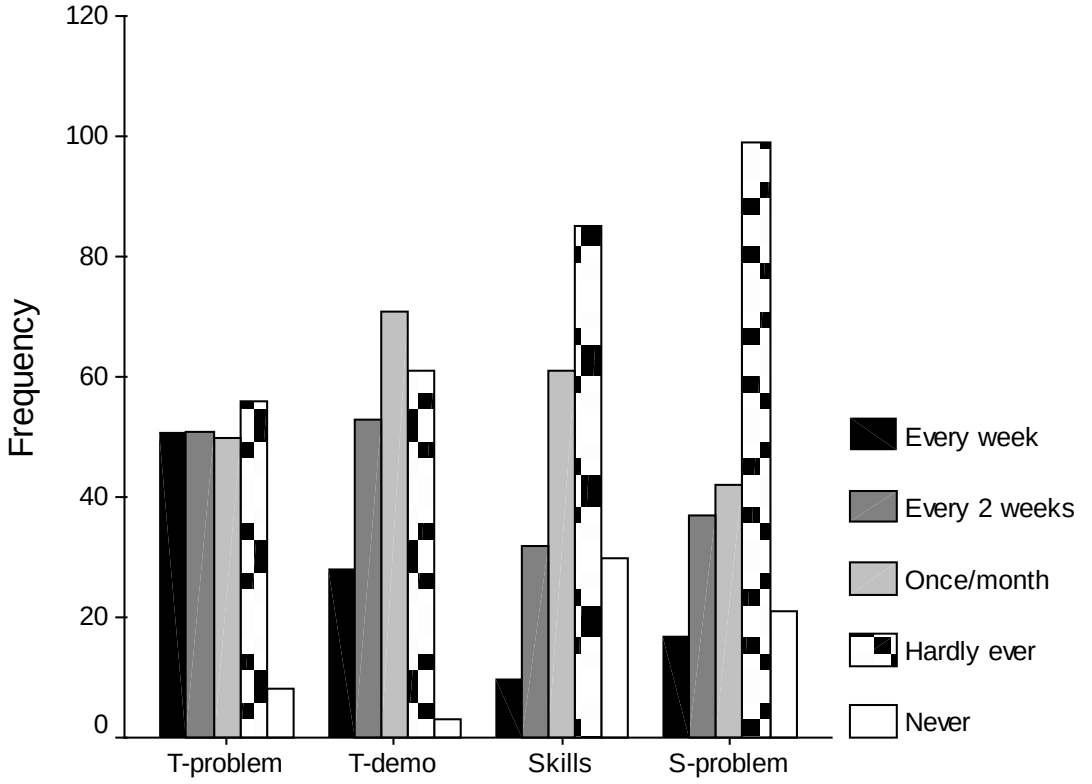

Figure 3.10. Frequency of different types of lab work

3.10. Research Questions #10 and #11

How do lower secondary science teachers rate the physical facilities available for teaching science?
How do lower secondary science teachers rate the educational resources available for teaching science?

More than half of the teachers (127 or 56.7%) described the physical facilities for teaching science (i.e., materials, equipment, and laboratory space) as "barely adequate" or "unsatisfactory," while 40 (17.9%) rated the facilities as "good" or "very good" (see Figure 3.11 and Table B16). The need for better physical facilities was expressed most strongly by teachers in the junior secondary schools, 5-year government/composite schools (including the SEMP pilot schools), and 5-year government-assisted schools (see Table B17). The vast majority of teachers (191 or 85.3%) indicated that their greatest need with respect to physical facilities was for better laboratory facilities and/or laboratory space.

A large number of teachers (166 or 74.1%) described the educational resources for teaching science (i.e., reference books, video tapes, CD ROMs, etc.) as "barely adequate"

or “unsatisfactory.” Only 17 teachers (7.6%) rated the educational resources as “good” or “very good” (see Figure 3.12 and Table B18). Educational resources were thought to be less than adequate by teachers in all school types, since the mean rating was less than 3 out of a maximum of 5 across all school types (see Table B19). Teachers described a wide range of educational resources that they felt they needed to teach science effectively. The most frequently cited need was for audio- and video-tapes (44 or 19.6%).

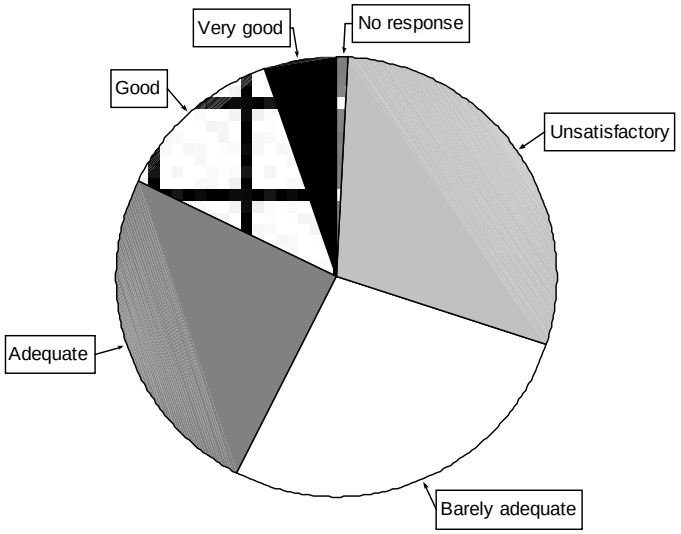

Figure 3.11. Distribution of ratings of physical facilities

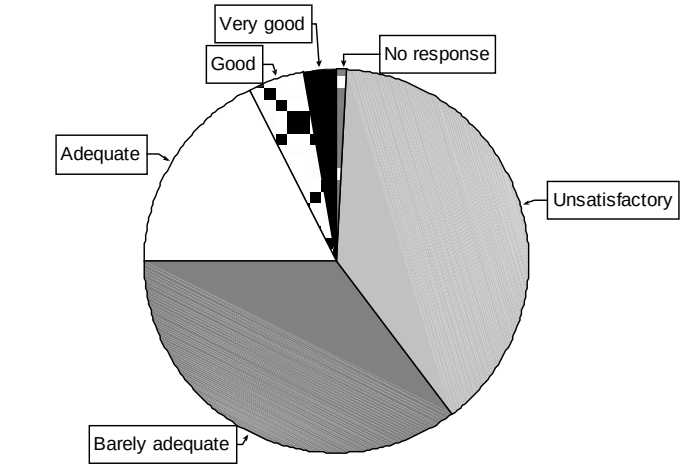

Figure 3.12. Distribution of ratings of educational resources

CHAPTER 4

Summary, Discussion, and Recommendations

4.1. Introduction

This chapter summarizes and discusses the research findings. It also addresses **Research Question #12** (*What changes, if any, have occurred in the provisions for, and execution of the teaching of lower secondary science between 1994 and the present time?)* by making comparisons, where possible, with the findings of the somewhat similar study that was conducted in Trinidad and Tobago in 1994 (George, 1995). The summary and discussion are organized around five main questions. The report ends with some recommendations for enhancing the teaching and learning of science at the lower secondary level.

4.2. Characteristics of Teachers

Who are the teachers of lower secondary science?

The overall characteristics of these teachers can be summarized as follows. Lower secondary science teachers:

- are mainly female (62.9%)
- are mainly 40 years of age or younger (68.4%)
- are mainly of East Indian descent (64.3%)
- are mainly graduates of 7-year government and government-assisted secondary schools (68.3%)
- typically possess a bachelor's degree (73.2%)
- have specialized mainly in the biological sciences and chemistry (67.4%)
- typically do not hold the Dip.Ed. (70.5%)

These findings are similar in many respects to those obtained in the 1994 study. These teachers are fairly young and are the products of 7-year government and government-assisted secondary schools in the main. They possess appropriate academic qualifications generally, but there are few of them who hold qualifications in physics. Not many of them have received postgraduate professional training. The junior secondary schools continue to have the smallest percentage of teachers with a B.Sc. degree and the Dip.Ed.

There were two areas where differences between the two studies surfaced, and these were with respect to the gender composition and ethnicity of these lower secondary science teachers. In the 1994 study, the gender imbalance was not as great (55.5% female teachers) and the proportion of teachers of East Indian descent was smaller (53.9%).

Some of the points raised in the 1994 study are worth repeating here. Teachers are operating in school cultures that might be different from the ones in which they functioned as secondary school students. Furthermore, many of these teachers have not been trained to teach, even though they may possess the necessary content knowledge. In addition, many lower secondary science teachers are likely to be teaching students who are different from them in some ways as, increasingly, boys are being taught by female teachers, and teachers may be teaching children of a different ethnicity.

These findings suggest that there may be the need for these science teachers (and perhaps teachers of other subjects as well) to be exposed to short courses that examine the interface between culture and schooling, even as the younger ones await the opportunity to pursue the Dip.Ed. The older teachers should be encouraged to enroll in the Dip.Ed. programme at the earliest opportunity. Unfortunately, the dearth of teachers with qualifications in physics who teach lower secondary science persists. This is likely to impact negatively on students' confidence in their ability to study physics and to pursue the subject at the upper secondary level.

4.3. The Curriculum

What is the nature of the lower secondary science curriculum?

The fact that teachers in the same school used different names to identify their lower secondary science curriculum suggests the absence of any philosophical base for teaching science at this level. The nature of the integration in "integrated science" is thus dubious. Most of the schools switch overtly to the separate sciences in Form 3 and this is perhaps the result of a school policy that preparation for the CXC examinations should begin at Form 3. However, there were a few schools that taught the separate sciences from Form 1 and/or Form 2.

With the exception of the SEMP pilot schools where the SEMP curriculum is being implemented, the nature of the science curriculum seemed to be determined by the teachers themselves, as evidenced by the wide variety of sources of the science curriculum cited. Textbooks featured prominently as a partial source of the curriculum and it is instructive that the texts by Hoong and Leng were used widely for this purpose. These are foreign texts and this signals that teachers feel that they are superior to those produced by Caribbean writers. This point is underscored by the fact that the Textbook Evaluation Committee of the Ministry of Education has recently recommended these texts for use at the lower secondary level. This is a new trend in that, in 1994, the texts in common use at the lower secondary level were written by Caribbean authors. This new trend towards the use of foreign texts is not entirely satisfactory since the science taught at this level should be closely linked to the students' everyday Caribbean experiences if that science is to be considered to be truly relevant.

Overall, the situation during the period of this piece of research was akin to the situation in the schools in 1994 when George (1995, p. 69) reported that:

> A very fluid situation seems to exist at the lower secondary level with respect to the science curriculum. It would seem that the quality of what is produced in a given school is very heavily dependent on the expertise of the science teachers in that school in the area of curriculum development. The localized initiatives to meet local needs are to be admired, but, perhaps there is the need for some training in the shaping of a curriculum for teachers, particularly since so many of them have not been trained professionally.

4.4. Resources for Teaching Science

What is the quality of the resources available for the teaching of lower secondary science?

Teachers reported that they were quite satisfied with the in-school support that they received for teaching lower secondary science. However, they were not as satisfied with the level of support from the Ministry of Education, and they were definitely dissatisfied with the level of support from UWI and ASETT. These sentiments provide further evidence that the quality of the lower secondary science curriculum in a given school is directly related to the expertise residing in that school.

Teachers were also dissatisfied with the physical facilities and educational resources available for teaching science. They indicated that they needed better laboratories, more laboratory space, and better instructional aids for teaching science.

This lack of proper resources was reported by many teachers, but most strongly by junior secondary teachers and teachers in the 5-year government and 5-year government-assisted schools. It is striking that nearly all the teachers in the SEMP pilot schools expressed dissatisfaction with the physical facilities and educational resources for teaching lower secondary science. This dissatisfaction with available resources resonates well with the findings in the 1994 study. Thus, provision for the teaching of lower secondary science continues to be regarded as being unsuitable. This is likely to impact significantly on the quality of what is offered in the science classrooms and laboratories.

4.5. Role of Practical Laboratory Work

What is the role of practical laboratory work in the teaching of lower secondary science?

Practical laboratory work does not seem to play a significant role in the teaching of lower secondary science, even in the SEMP pilot schools. Teachers reported that when practical work is done, it typically takes the form of teacher demonstrations or teacher-generated problem-solving activity. One limitation of this item on the questionnaire was that it did not seek to determine what teachers classified as “problem-solving activity.” It is clear, though, that the students did not have much opportunity to manipulate laboratory apparatus themselves or to pursue the solution of problems that they had identified. In the 1994 study, this lack of the direct involvement of students in practical work was also

highlighted. It is also noteworthy that the frequency of practical laboratory work decreased as students moved from Form 1 to Form 3, almost in tandem with the shift toward CXC science. These findings are not surprising, given the reported lack of appropriate physical facilities for teaching science, and given the high percentage of untrained science teachers who might not have the skill to make maximum use of whatever facilities are available.

4.6. Problems Encountered by Teachers

What problems are encountered in the teaching of lower secondary science?

The most serious problems identified by teachers were related to physical provisions—inadequate funding for the purchase of equipment and supplies, and large class sizes. Teachers did not (could not?) identify areas for personal professional development.

4.7. Recommendations

This study was undertaken to assess teachers' views about the state of lower secondary science in our schools and to compare these views with those expressed by lower secondary science teachers eight years ago. The overall conclusion is that not much has changed in the 8-year period. New schools have been opened and new curricula have been designed under the SEMP initiative and are being piloted in some of these new schools. Some other schools make use of the SEMP curricula but, generally, teachers decide what is to be done in their schools. Many of the teachers are still untrained, even though they possess the academic qualifications. Several of them are likely to be teaching students of a different ethnicity and in a school culture that is different from the one in which they were schooled. Most teachers are still unhappy with the level of provision for teaching lower secondary science with respect to physical facilities and educational resources.

Against this backdrop, the following recommendations are made:

1. All science teachers at this level (and perhaps all teachers in the system) need to be exposed to a course that examines the interface between culture and schooling so that they would be better equipped to deal with teaching in unfamiliar school settings, and teaching children of different ethnicities. Ultimately, all science teachers need to be professionally trained.

2. Because of the relatively low percentage of male lower secondary science teachers, special care must be taken to ensure that both male and female students are adequately catered for in the teaching of science. One approach might be to specifically target male recruits for the teaching of lower secondary science. Another strategy might be to undertake a thorough examination of the science curriculum and the teaching strategies used to ensure that there is no gender bias.

3. There is a lot of variation in what is offered in science at this level. While local school initiatives in science curriculum development are healthy, there should be a larger framework into which all the lower secondary science curricula fit. The idea of a SEMP core with enrichment modules put forward by the Ministry of Education does not seem to have borne much fruit thus far. Perhaps this could be further encouraged through the engagement of teachers in the production of science teaching resource materials as outlined below.

4. Most teachers complained about the lack of educational resources for teaching science. Some of these materials would need to be obtained commercially. However, the teachers themselves can be engaged in well-structured teacher resource development exercises, using concept maps as the starting point. These maps would include the basic concepts covered in the SEMP material plus the enrichment concepts. Care should be taken to ensure that physics concepts are included. Teachers from the different school types should be involved in this exercise to ensure that all needs are met.

5. Preparation for CXC science begins in Form 2 in many schools. The movement from lower secondary science to CXC science could be enhanced by the preparation of transitional units that maintain some of the integration that should characterize lower secondary science, while pointing toward concepts in the separate sciences. These transitional units can again be prepared by teachers in workshops.

6. Practical work in science needs to be specially targeted in training workshops. Teachers admitted that they did not engage in much student-centred practical activity and this needs to be corrected if students are to develop a view of science as inquiry.

7. Suitable physical facilities and the adequate provision of materials and equipment are needed for the teaching of science. Teachers are not satisfied with provisions in this area. These are major issues that need to be attended to at the appropriate levels. As far as the day-to-day running of the schools goes, principals should be provided with an appropriate vote to ensure that laboratories are properly stocked.

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APPENDIX A

LOWER SECONDARY SCIENCE TEACHER QUESTIONNAIRE

DO NOT WRITE IN THIS MARGIN

ID 1 [ ][ ][ ]

1. At what type of secondary school do you now teach?
   - [ ] Junior Secondary (shift)
   - [ ] Junior Secondary (all day)
   - [ ] 5-year Government/Composite
   - [ ] 5-year Assisted
   - [ ] 2 or 4 years Senior Secondary/Senior Comprehensive
   - [ ] 7-year Government (all types)
   - [ ] 7-year Assisted
   - [ ] Other (**please specify**)

   _____ [ ]

2. How old are you?
   - [ ] Under 21 years
   - [ ] 21 - 30 years
   - [ ] 31 - 40 years
   - [ ] 41 - 50 years
   - [ ] Above 50 years

   [ ]

3. What is your sex?
   - [ ] Female
   - [ ] Male

   [ ]

4. To what racial or ethnic grouping would you say you belong?
   - [ ] African
   - [ ] Chinese
   - [ ] East Indian
   - [ ] Mixed
   - [ ] Other (**please specify**)

   _____ [ ]

5. What type of secondary school(s) did you attend as a student? Tick more than one box if necessary

[ ] Junior Secondary
[ ] 5-year Composite
[ ] 5-year Government
[ ] 5-year Assisted
[ ] Senior Comprehensive
[ ] Senior Secondary
[ ] Senior Secondary Comprehensive
[ ] 7-year Government
[ ] 7-year Assisted
[ ] Other (**please specify**)

_____

6. How long have you been a secondary school science teacher (any level)?

[ ] 3 years or less
[ ] 4 - 10 years
[ ] 11 - 20 years
[ ] more than 20 years

7. How long have you been teaching lower secondary science (i.e. Form 1 and/or Form 2 and/or Form 3) in your present school?

[ ] 3 years or less
[ ] 4 - 10 years
[ ] 11 - 20 years
[ ] more than 20 years
[ ] Other (please describe your teaching schedule if you have not taught science at this level continuously)

_____

_____

_____

_____

11

8. What is the **highest academic qualification** in science that you hold?

[ ] No qualifications in science
[ ] "O" Level /CXC
[ ] "A" Level
[ ] B.Sc.
[ ] M.Sc.
[ ] Other (**please specify**)

9. Please indicate your area(s) of specialisation in #8 above.

10. What are your **professional** qualifications/experiences in education? Tick more than one box if necessary.

[ ] No professional training in education
[ ] Cert. Ed.
[ ] B.Ed.
[ ] Dip. Ed.
[ ] M.Ed.
[ ] M.A.(Ed.)
[ ] Other (CXC panel, CXC marking, Ministry/CXC workshops, etc. **Please specify**)

11. What is the MAIN science subject that you now teach at the lower secondary level?

[ ] General Science/Science
[ ] Integrated Science
[ ] Biology
[ ] Chemistry
[ ] Physics
[ ] Other (**please specify**)

12. What is the SOURCE of your current lower secondary science syllabus/curriculum? Please tick the appropriate box/ boxes for each Form.

		Form 1	Form 2	Form 3
(a)	Textbook			
(b)	Ministry of Education			
(c)	Head of Department			
(d)	Combined Effort of Lower Secondary Science Teachers			
(e)	CXC Integrated Science Syllabus			
(f)	CXC Biology Syllabus			
(g)	CXC Chemistry Syllabus			
(h)	CXC Physics Syllabus			
(i)	NCSE Science Curriculum			
(j)	SEMP Science Curriculum			
(k)	Other (**please specify**)			

20

13. Please state the science subject(s) taught (Integrated Science, Science, Chemistry, Biology, Physics, etc.) and the MAIN science text used in each of the three lower secondary forms in your school.

Form	Science subject taught	Text Title	Author(s)
Form 1			
Form 2			
Form 3			

14. Please list below the additional skills you think you need to be able to teach lower secondary science more effectively. Please list the most critical need first.

30

15. How would you rate the support you receive from various stakeholders in your teaching of lower secondary science? Please use the rating scale provided below:

	Stakeholders	Support received			
		Very Good	Good	Satisfactory	Poor
a)	Your school				
b)	Ministry of Education				
c)	Association for Science Education of Trinidad and Tobago				
d)	The University of the West Indies				
e)	Others (**please specify**)				

16. Please indicate the time allocated to lower secondary science on your timetable.

Class	No. of periods per week	Length of ONE period (in minutes)
Each Form 1 class		
Each Form 2 class		
Each Form 3 class		

41

17. On an average, how often do you have practical laboratory work in your lower secondary classes?

Class	Every week	Every two weeks	Once per month	Once per term	Hardly Ever	Never
Form 1						
Form 2						
Form 3						

50 [ ]

18. Below are listed different types of practical laboratory activities. Please indicate the frequency with which these are done in your lower secondary science classes by using the following scale:

1 Never

2 Hardly Ever

3 Once per term

4 Once per month

5 Every two weeks

6 Every week

(a) [ ] Practical activities to develop skill in handling apparatus [ ]

(b) [ ] Teacher demonstrations [ ]

(c) [ ] Student-generated problem-solving activities [ ]

(d) [ ] Teacher-generated problem-solving activities [ ]

(e) [ ] Traditional practical procedures, e.g. food tests, distillation, setting up an electrical circuit [ ]

(f) [ ] Practical activities to verify established scientific laws and principles, e.g. pressure-volume relationship of gas, Hooke's Law [ ]

19. How would you describe the physical facilities (i.e. materials, equipment and laboratory space) for practical laboratory work in science in Forms 1-3 in your school?

[ ] Very Good
[ ] Good
[ ] Adequate
[ ] Barely adequate
[ ] Unsatisfactory

20. Please describe your GREATEST NEED with respect to physical facilities. 60

21. How would you describe the educational resources (such as reference books, charts, audio-tapes, video-tapes, CD roms) available in your school for teaching lower secondary science?

[ ] Very Good
[ ] Good
[ ] Adequate
[ ] Barely adequate
[ ] Unsatisfactory

22. Describe your GREATEST NEED with respect to educational resources

23. In your opinion, to what degree do the points listed in (a) to (o) below contribute to problems in science education at the lower secondary level in your school? Use the following scale to rate the points?

1 Not a problem
2 Rarely a problem
3 Frequently a problem
4 A serious problem

[ ]	(a) Belief that science is less important than other subjects	
[ ]	(b) Inadequate laboratory facilities	
[ ]	(c) Insufficient funds for purchasing equipment and supplies	
[ ]	(d) Out-of-date teaching materials	
[ ]	(e) Lack of interest in science by girls	
	(f) Lack of interest in science by boys	
[ ]	(g) Teachers inadequately prepared to teach science	
[ ]	(h) Class size too large	
[ ]	(i) Too many class preparations per day	
[ ]	(j) Lack of colleagues with whom to discuss science teaching problems	
[ ]	(k) Insufficient student problem solving skills	
[ ]	(l) Lack of science career role models in the community	
[ ]	(m) Poor student reading ability	
[ ]	(n) Insufficient number of textbooks	
[ ]	(o) The everyday beliefs and practices of students	
[ ]	(p) Administrative decisions such as time-tabling, staff allocations	

24. Please list any other SEROUS PROBLEMS that you experience in teaching lower secondary science that are not listed in #23(a)-(o) above.

80 | | |

THANK YOU VERY MUCH

APPENDIX B

Statistical Tables

Table B1. Gender of Teachers

Gender	Frequency	Percent
No response	1	0.4
Female	141	62.9
Male	81	36.2
Invalid response	1	0.4
Total	**224**	**100.0**

Table B2. Age of Teachers

Age range	Frequency	Percent
No response	1	0.4
Under 21 yrs	8	3.6
21 – 30 yrs	75	33.5
31 – 40 yrs	70	31.3
41 – 50 yrs	41	18.3
Above 50 yrs	27	12.1
Invalid response	2	0.9
Total	**224**	**100.0**

Table B3. Ethnicity of Teachers

Ethnicity	Frequency	Percent
No response	6	2.7
African	47	21.0
Chinese	1	0.4
East Indian	144	64.3
Mixed	24	10.7
Invalid response	2	0.9
Total	**224**	**100.0**

Table B4. Secondary School Type Attended by Teachers

School type	Frequency	Percent
No response	4	1.8
5-yr Government	12	5.4
7-yr Government	30	13.4
7-yr Government assisted	123	54.9
Junior Secondary + Senior secondary/Comprehensive	13	5.8
Junior secondary + 7-year Government	2	0.9
Other combinations	40	17.9
Total	**224**	**100.0**

Table B5. Academic Qualifications of Teachers

Qualification	Frequency	Percent
CXC/O-level	4	1.8
A-level/Associate degree/Diploma	44	19.6
Bachelor's degree	164	73.2
Master's degree	12	5.4
Total	**224**	**100.0**

Table B6. Frequency Distribution of Academic Qualifications of Teachers by School Type

School type	Academic qualifications			Total
	CXC/O-level	A-Level/Associate degree/Diploma	Bachelor's/Master's degree	
Junior secondary	4 * 7.0 +100.0%	15 26.3% 34.1%	38 66.7% 21.6%	57 100.0% 25.4%
5-yr Government/Composite		15 26.8% 34.1%	41 73.2% 23.3%	56 100.0% 25.0%
5-yr Government assisted		1 10.0% 2.3%	9 90.0% 5.1%	10 100.0% 4.5%
7-yr Government		5 13.2% 11.4%	33 86.8% 18.8%	38 100.0% 17.0%
7-yr Government assisted		8 12.7% 18.2%	55 87.3% 31.3%	63 100.0% 28.1%
Total	**4** **1.8%** **100.0%**	**44** **19.6%** **100.0%**	**176** **78.6%** **100.0%**	**224** **100.0%** **100.0%**

* = Row percentage
+ = Column percentage

Table B7. Professional Qualifications of Teachers

Qualification	Frequency	Percent
None	83	37.1
Cert. Ed.	8	3.6
B.Ed.	1	0.4
Dip. Ed.	62	27.7
M.Ed.	4	1.8
Other	63	28.1
No/Invalid response	3	1.3
Total	**224**	**100.0**

Table B8. Frequency Distribution of Professional Qualification of Teachers by School Type

School Type	Professional Qualifications							Total
	None	Cert. Ed.	B.Ed.	Dip. Ed.	M.Ed.	Other	No/Invalid response	
Junior secondary	22 *38.6% +26.5%	5 8.8% 62.5%		12 21.1% 19.4%		15 26.3% 23.8%	3 5.3% 100.0%	57 100.0% 25.4%
5-yr Government/ Composite	23 41.1% 27.7%	1 1.8% 12.5%		16 28.6% 25.8%	2 3.6% 50.0%	14 25.0% 22.2%		56 100.0% 25.0%
5-yr Government assisted	4 40.0% 4.8%			2 20.0% 3.2%		4 40.0% 6.3%		10 100.0% 4.5%
7-yr Government	9 23.7% 10.8%	1 2.6% 12.5%	1 2.6% 100.0%	15 39.5% 24.2%		12 31.6% 19.0%		38 100.0% 17.0%
7 yr Government assisted	25 39.7% 30.1%	1 1.6% 12.5%		17 27.0% 27.4%	2 3.2% 50.0%	18 28.6% 28.6%		63 100.0% 28.1%
Total	**83** **37.1%** **100.0%**	**8** **3.6%** **100.0%**	**1** **0.4%** **100.0%**	**62** **27.7%** **100.0%**	**4** **1.8%** **100.0%**	**63** **28.1%** **100.0%**	**3** **1.3%** **100.0%**	**224** **100.0%** **100.0%**

* = Row percentage
+ = Column percentage

Table B9. Frequency Distribution of Areas of Specialization of Teachers

Area of specialization	Frequency	Percent
No response	32	14.3
Biology/Zoology/Botany	43	19.2
Chemistry	37	16.5
Physics	18	8.0
Engineering	2	0.9
Agriculture	6	2.7
Biology + biochemistry	17	7.6
Chemistry + physics	12	5.4
Chemistry + biological sciences	54	24.1
Invalid response	3	1.3
Total	**224**	**100.0**

Table B10. Frequency Distribution of Sources of the Form 1 Curriculum

Source of the curriculum	Frequency	Percent
No response	52	23.1
Text only	20	8.9
SEMP or NCSE	27	12.1
Text + syllabuses	40	17.9
Internal effort + text	22	9.8
Other	63	28.1
Total	**224**	**100.0**

Table B11. Frequency Distribution of Sources of the Form 2 Curriculum

Source of the curriculum	Frequency	Percent
No response	54	24.1
Text only	22	9.8
SEMP or NCSE	23	10.3
Text + syllabuses	37	16.5
Internal + text	25	11.2
Other	63	28.1
Total	**224**	**100.0**

Table B12. Frequency Distribution of Use of Science Texts in Form 1 by School Type

School type	Science texts				
	Hoong et al. Book 1	Durgadeen et al. Book 1	Commissiong et al. Book 1	Other	Total
Junior secondary	8 *66.7%	3 25.0%	0 0.0%	1 8.3%	**12** **100%**
5-yr Government/Composite	13 56.5%	4 17.4%	3 13.0%	3 13.0%	**23** **100%**
5-yr Government assisted	2 33.3%	4 66.7%	0 0.0%	0 0.0%	**6** **100%**
7-yr Government	5 45.5%	1 9.1%	3 27.3%	2 18.2%	**11** **100%**
7-yr Government assisted	10 52.6%	4 21.1%	1 5.3%	4 21.1%	**19** **100%**
Total	**38** **53.5%**	**16** **22.5%**	**7** **9.9%**	**10** **14.1%**	**71** **100%**

* = Row percentage

Table B13. Frequency Distribution of Use of Science Texts in Form 2 by School Type

School type	Hoong et al. Book 1 and/or Book 2	Durgadeen/Stewart et al. Book 1 and/or Book 2	Commissiong et al. Book 1 and/or Book 2	Other texts	No texts specified	Total
Junior secondary	8 *66.7%	2 16.7%	0	1 8.3%	1 8.3%	**12** **100%**
5-yr Government/Composite	12 52.2%	#5 21.7%	#5 21.7%	1 4.3%	1 4.3%	**23** **100%**
5-yr Government assisted	2 33.3%	2 33.3%	0 0.0%	1 16.7%	1 16.7%	**6** **100%**
7-yr Government	4 36.4%	1 9.1%	3 27.3%	3 27.3%	0 0.0%	**11** **100%**
7-yr Government assisted	6 31.6%	4 21.1%	2 10.5%	5 26.3%	2 10.5%	**19** **100%**
Total	**32** **45.1%**	**14** **19.7%**	**10** **14.1%**	**11** **15.5%**	**5** **7.0%**	**71** **100%**

* = Row percentage
# One school uses both of these

Table B14. Frequency Distribution of Ratings of Stakeholder Support for the Teaching of Science

Stakeholder	Rating of support					
	Very Good	Good	Satisfactory	Poor	No response	Total
School	55 *24.6%	85 37.9%	66 29.5%	15 6.7%	3 1.3%	224 100%
Ministry of Education	6 2.7%	19 8.5%	73 32.6%	105 46.9%	21 9.4%	224 100%
ASETT	1 0.4%	9 4.0%	27 12.1%	133 59.4%	54 24.1%	224 100%
UWI	1 0.4%	7 3.1%	30 13.4%	139 62.1%	47 21.0%	224 100%

* = Row percentage

Table B 15. Frequency of Different Types of Laboratory Work in Forms 1–3

Type of laboratory work	Frequency						
	Every week	Every 2 weeks	Once/month	Hardly ever	Never	No/Invalid response	Total
Teacher-generated problem-solving activity	51 *22.8%	51 22.8%	50 22.3%	56 25.0%	8 3.6%	8 3.6%	224 100.0%
Teacher demonstrations	28 12.5%	53 23.7%	71 31.7%	61 27.3%	3 1.3%	8 3.6%	224 100.0%
Handling apparatus	10 4.5%	32 14.3%	61 27.2%	85 38.0%	30 13.4%	6 2.6%	224 100.0%
Student-generated problem-solving activity	17 7.6%	37 16.5%	42 18.8%	99 44.2%	21 9.4%	8 3.6%	224 100.0%

* = Row percentage

Table B16. Ratings of Physical Facilities for Teaching Science

	Frequency	Percent
No responses	2	0.9
Unsatisfactory	65	29.0
Barely adequate	62	27.7
Adequate	55	24.6
Good	28	12.5
Very good	12	5.4
Total	**224**	**100.0**

Table B17. Mean of Ratings of Physical Facilities by School Type

School type	Mean	N	Std. deviation
Junior secondary	2.05	57	1.13
5-yr Government/Composite	1.96	56	1.21
5-yr Government assisted	1.80	10	0.79
7-yr Government	2.66	38	1.07
7-yr Government assisted	2.86	63	1.78
Total	**2.35**	**224**	**1.20**

Highest possible mean rating = 5 (Very good)

Table B18. Ratings of Educational Resources for Teaching Science

	Frequency	Percent
No response	2	.9
Unsatisfactory	87	38.8
Barely adequate	79	35.3
Adequate	39	17.4
Good	11	4.9
Very good	6	2.7
Total	**224**	**100.0**

Table B19. Mean of Ratings of Educational Resources by School Type

School type	Mean	N	Std. deviation
Junior secondary	1.89	57	.96
5-yr Government/Composite	1.55	56	.74
5-yr Government assisted	2.00	10	.47
7-yr Government	2.03	38	1.17
7-yr Government assisted	2.29	63	1.14
Total	**1.95**	**224**	**1.02**

Highest possible mean rating = 5 (Very good)