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**SCHOOL OF EDUCATION  
FACULTY OF HUMANITIES AND EDUCATION  
THE UNIVERSITY OF THE WEST INDIES  
ST. AUGUSTINE**

**Lower Secondary Science Teaching and Learning  
Teachers' Characteristics and Perspectives  
Summary Report**

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School of Education  
2004

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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## TABLE OF CONTENTS

Preface	ii
Acknowledgements	iii
List of Tables	iv
List of Figures	iv
Background to the Study	1
1. Introduction	1
2. Research Questions	2
Methodology	3
1. The Instrument	3
2. The Sample	3
3. The Response	3
Findings	5
1. Research Question #1	5
2. Research Question #2	9
3. Research Question #3	9
4. Research Question #4	10
5. Research Question #5	12
6. Research Question #6	12
7. Research Question #7	12
8. Research Questions #8 and #9	12
9. Research Questions #10 and #11	13
Discussion	16
Recommendations	19
References	21



## **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**

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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.

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## **LIST OF TABLES**

1. Frequency of Response of Teachers by School Type	4
2. Frequency of Response of Schools and Teachers by Educational Division	4
3. Frequency Distribution of Areas of Specialization of Teachers	8

## **LIST OF FIGURES**

1. Age Distribution of Teachers	6
2. Distribution of Teachers by Ethnicity	6
3. Distribution of Teachers by School Types Attended	7
4. Distribution of Teachers' Academic Qualifications	7
5. Distribution of Teachers' Professional Qualifications	8
6. Distribution of Sources of Form 1 Curriculum	11
7. Distribution of Sources of Form 2 Curriculum	11
8. Ratings of Support for Teaching Science	14
9. Frequency of Laboratory Work	14
10. Distribution of Ratings of Physical Facilities	15
11. Distribution of Ratings of Educational Resources	15



## **BACKGROUND TO THE STUDY**

### **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 Cambridge International Examinations. 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 [T&T]. Ministry of Education, 1995), and the Secondary Education Modernisation Programme (SEMP) science syllabus (T&T. 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.

## **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?

## **METHODOLOGY**

### **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.

### **2. The Sample**

The decision was taken to target all the 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.

### **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 1 shows the origin of the completed questionnaires by school type, and Table 2 shows the data by educational division. 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.

**Table 1. Frequency of Response of Teachers by School Type**

<b>School type</b>	<b>Number of schools with lower secondary sector</b>	<b>Number of schools responding</b>	<b>% of schools responding</b>	<b>Number of teachers responding</b>	<b>Average no. of teachers per school responding</b>
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
<b>TOTAL</b>	<b>115</b>	<b>71</b>	<b>61.7</b>	<b>224</b>	<b>3.2</b>

**Table 2. Frequency of Response of Schools and Teachers by Educational Division**

<b>Educational division</b>	<b>Number of schools with a lower secondary sector</b>	<b>Number of schools responding</b>	<b>% of schools responding</b>	<b>Number of teachers responding</b>	<b>Average no. of teachers per school responding</b>
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
<b>TOTAL</b>	<b>115</b>	<b>71</b>	<b>58.7</b>	<b>224</b>	<b>3.1</b>

## FINDINGS

The findings of the study are presented with reference to the various research questions.

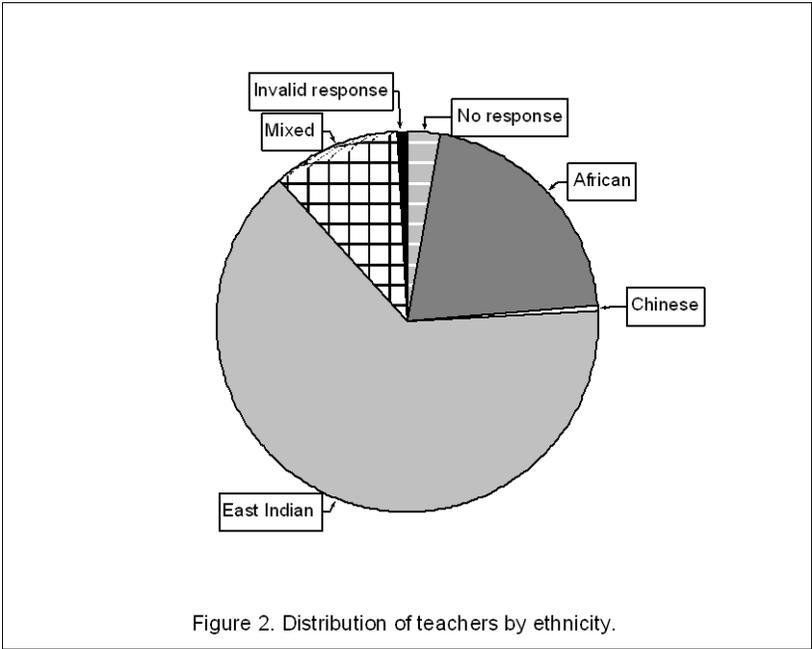
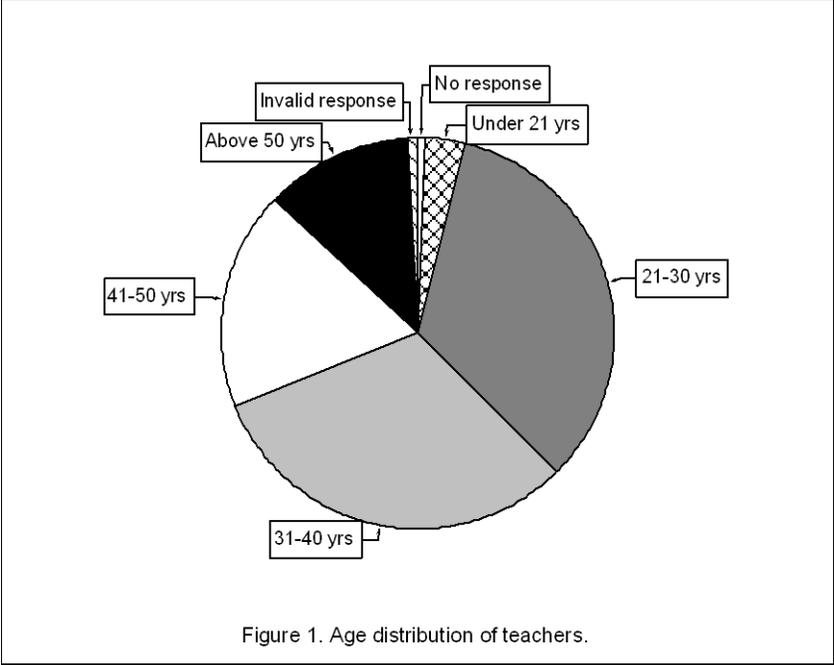
### 1. Research Question #1:

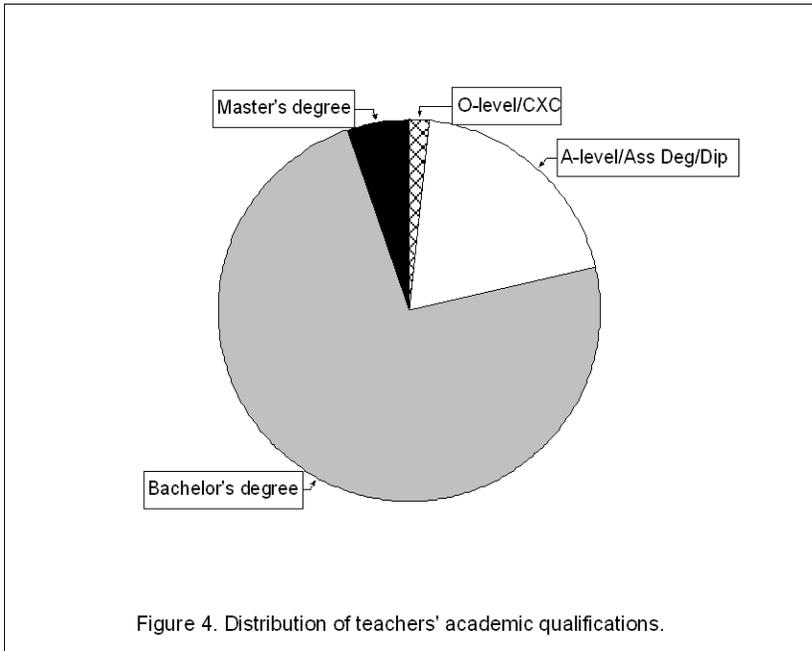
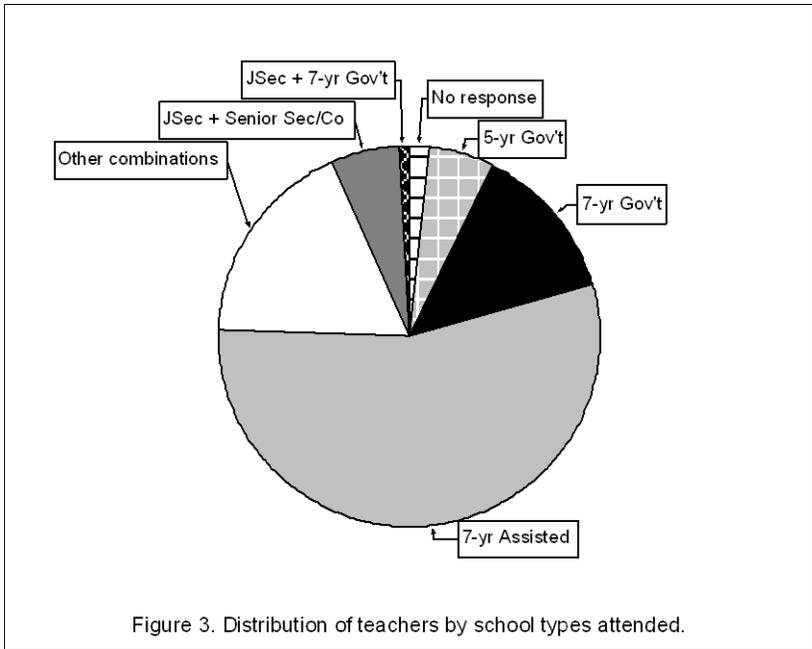
*What are the characteristics and qualifications of science teachers at the lower secondary level of the public secondary schools in Trinidad and Tobago?*

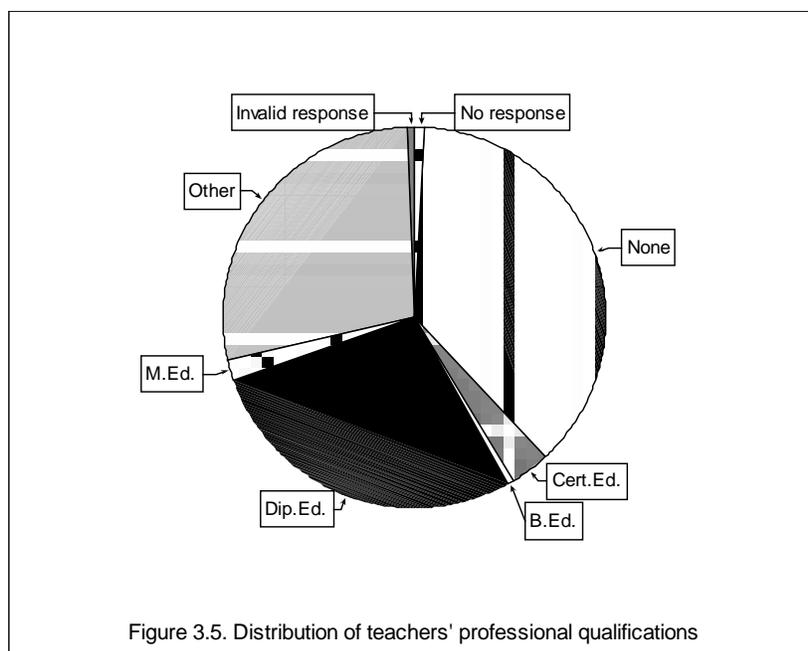
The overall characteristics and qualifications, as gleaned from the reports of these teachers, can be summarized as follows:

- 68.4% were 40 years of age or younger (see Figure 1)
- 62.9% were female
- 64.3% were of East Indian descent and 21.0% were of African descent (see Figure 2)
- 54.9% were graduates of 7-year government-assisted secondary schools and 13.4% were graduates of 7-year government secondary schools (see Figure 3)
- 73.2% possessed a bachelor's degree (see Figure 4)
- 70.5% did **not** hold the Diploma in Education (see Figure 5)
- 67.4% had specialized mainly in the biological sciences and/or chemistry, and 8.0% had specialized in physics (see Table 3)

When the characteristics were examined by school type, it was found that 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. It was also found that the relatively high percentage of untrained science teachers exists in practically all school types. 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 (represented as "Other" in Figure 5).







**Table 3. 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
<b>Total</b>	<b>224</b>	<b>100.0</b>

## **2. Research Question #2:**

*What science subjects are taught at this level?*

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.

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.

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 in Form 3, and the 12<sup>th</sup> school continued to offer the separate sciences, as it had done in Form 2.

## **3. Research Question #3:**

*What is the source of the lower secondary science curriculum?*

### **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 their school was used along with the text. A large number of “other” curriculum sources was 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 6).

## **Form 2**

The situation with respect to the science curriculum in Form 2 was very similar to that in Form 1 (see Figure 7). Again, a large number of the teachers who did not respond to this item (40 out of 54) did not teach Form 2 science.

## **Form 3**

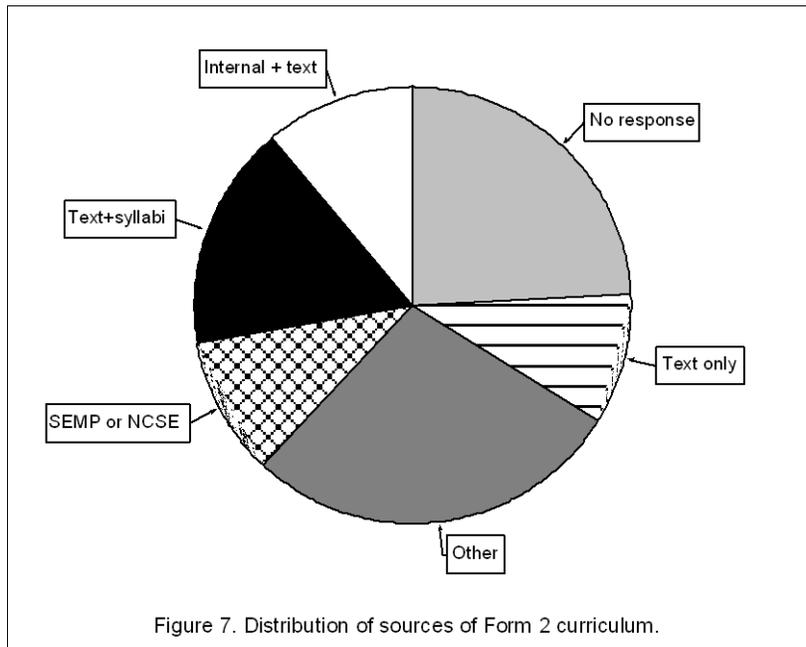
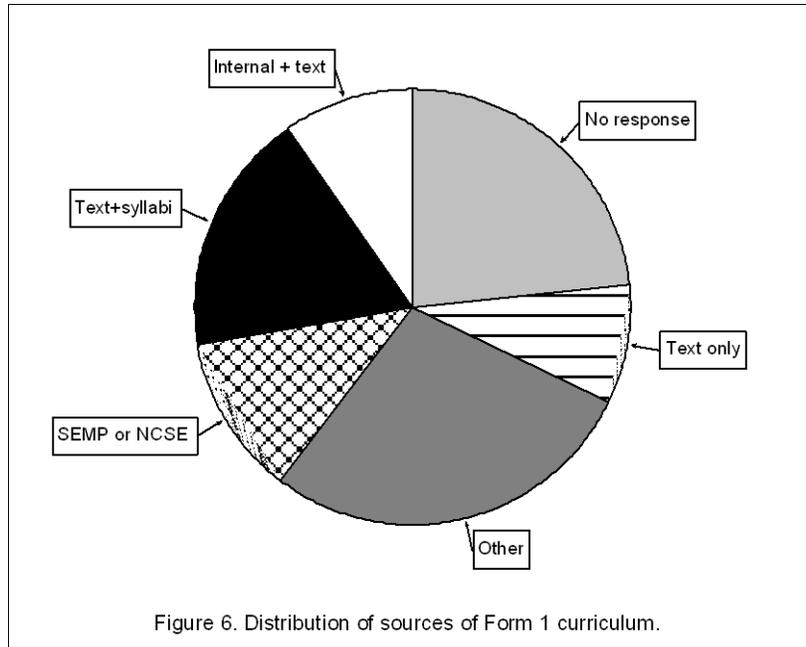
The situation changed drastically in Form 3. Some schools that were not SEMP pilot schools continued to draw on the SEMP syllabus. Thirty teachers (13.4%) stated that they used a text along with two or more of the SEMP/NCSE/CXC syllabuses, while 29 teachers (12.9%) said that they used the CXC syllabi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

### **4. Research Question #4:**

*What are the science texts in use?*

The two texts, *Lower Secondary Science, Book 1* and *Book 2* (or the newer versions--*New Lower Secondary Science*) by Tho Lai Hoong and Ho Peck Leng, were the most popular in Form 1 and Form 2. Thirty-eight of the 71 schools (53.5%) used the *Book 1* version in Form 1, and 32 schools (45.1%) used the two books (mainly *Book 2*) in Form 2. These texts were especially popular among the junior secondary schools.

In Form 3, most junior secondary schools used the *Book 2* version of the Hoong and Leng texts. However, there were many texts and combinations of texts in use in the other school types. 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.



## **5. 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

## **6. 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.

## **7. 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 such as the Association for Science Education of Trinidad and Tobago (ASETT) and UWI. 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 8).

## **8. 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 9). Teachers in all of the SEMP schools in the sample reported that they hardly ever did practical laboratory work with their students.

Two-thirds of the teachers reported that they engaged in teacher-generated, problem-solving, practical activities, and teacher demonstrations at least once per month. Less prevalent were practical activities for developing skill in handling apparatus, and student-generated, problem-solving practical activities.

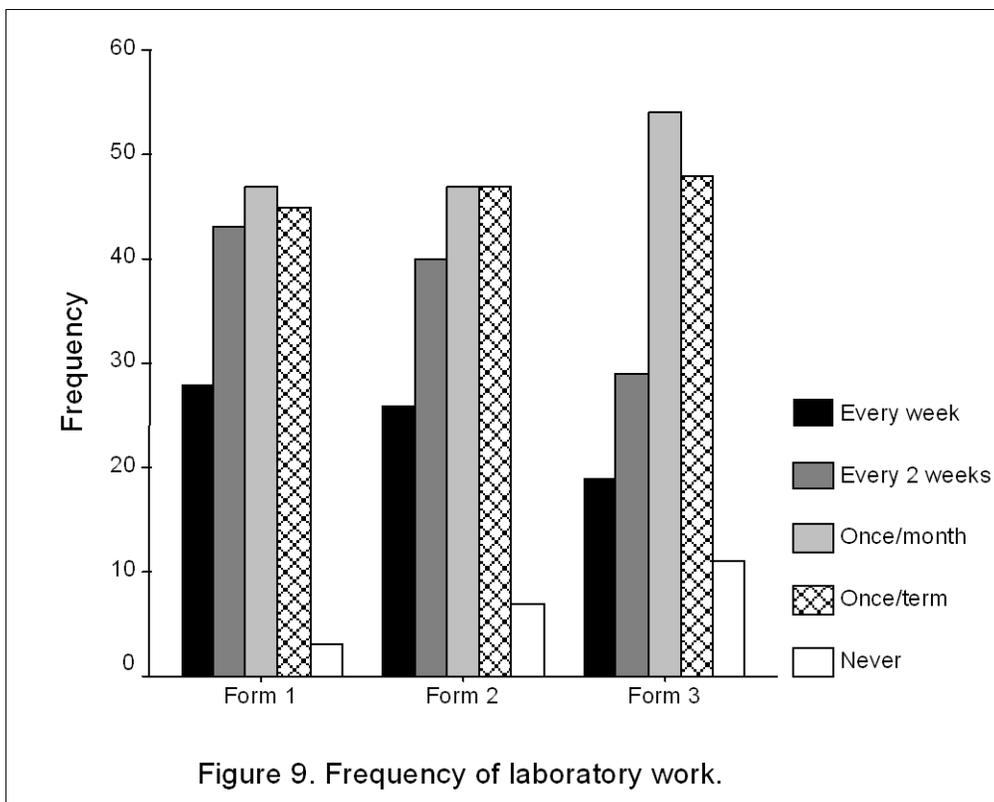
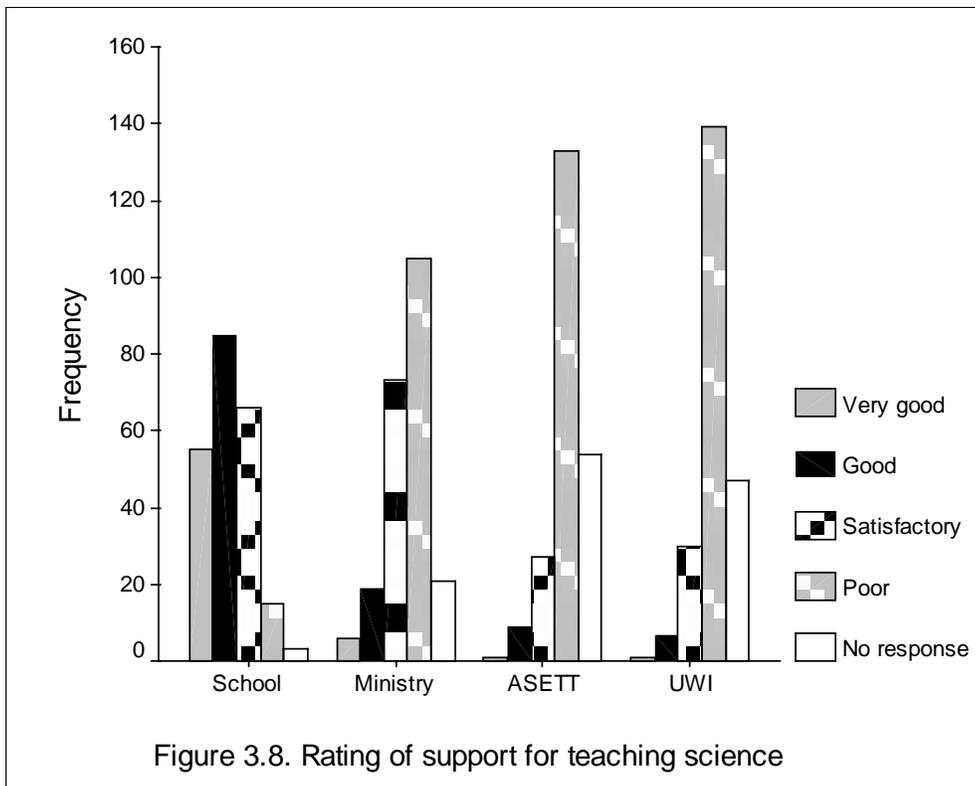
## **9. Research Questions #10 and #11**

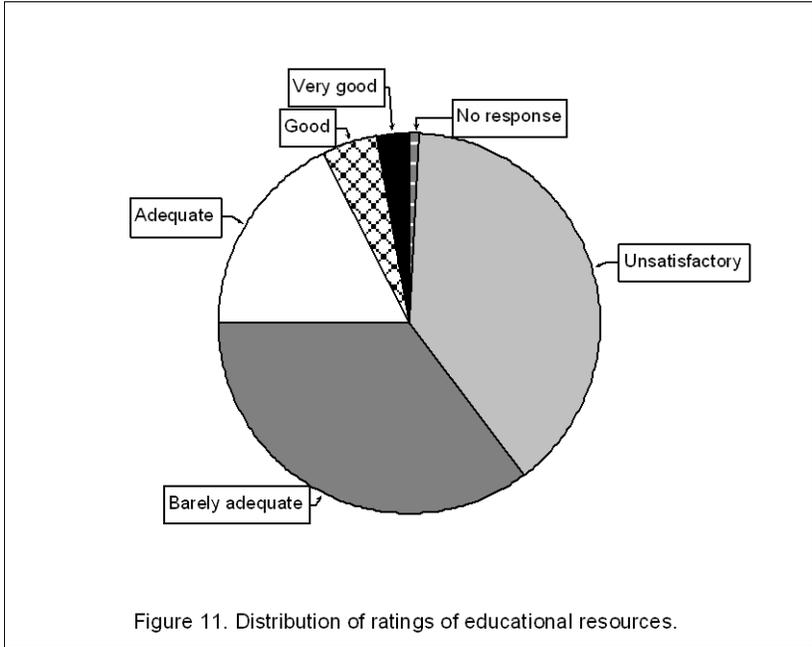
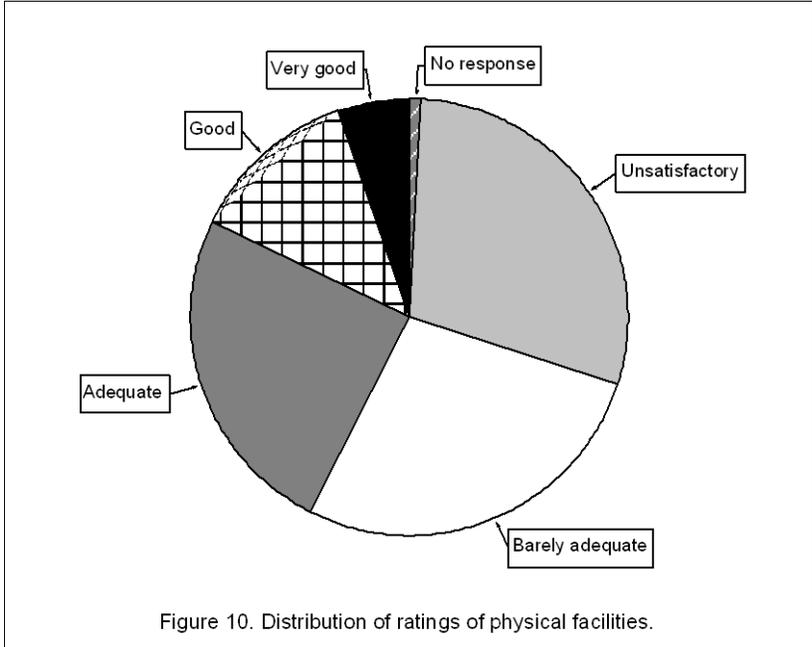
*How do lower secondary science teachers rate the physical facilities available for teaching science?*

*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” (see Figure 10). 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. 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, videotapes, CD ROMs, etc.) as “barely adequate” or “unsatisfactory” (see Figure 11). Educational resources were thought to be less than adequate by teachers in all school types. Teachers described a wide range of educational resources, which they felt they needed to teach science effectively. The most frequently cited need was for audio- and video-tapes (44 or 19.6%).





## DISCUSSION

The findings with respect to the characteristics and qualifications of the teachers 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 with 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.

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. In fact, there were a few schools that taught the separate sciences from Form 1 and/or Form 2.

With the exception of the 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 with respect to the lower secondary science curriculum 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.

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.

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.

## RECOMMENDATIONS

The following recommendations are made, based on the findings of the study:

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 bigger frame 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 as 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.
- 1) 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 big 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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