SCIENCE EXAMINATIONS' RESULTS IN BARBADOS, JAMAICA, AND TRINIDAD AND TOBAGO, 1982-1991[1]

Peter Whiteley

In this paper, data concerning the results of science examinations, at both the secondary and tertiary levels, in Barbados, Jamaica, and Trinidad and Tobago are presented within the context of the development of the territories. Trends in the data are identified and comparisons made among the three countries. Finally, some of the factors that may be affecting these examination results are briefly discussed.

Science Education and National Development

Science education is often mentioned by politicians and other Caribbean leaders as being important in the process of national development. The Jamaican Government's Five-Year Development Plan 1990-1995 (Planning Institute of Jamaica, 1991) states "Given the acknowledged link between education, science and technology, and economic growth (we must) develop a strategy which capitalizes on this interaction" (p. 2). One of the aims stated in that document is to "develop an action plan for science and technology to ensure that the education system keeps pace with local and international developments in science and technology" (p. 45). The need to improve the scientific research capacity and to put greater emphasis on science and technology at the University of the West Indies is mentioned (p. 48), and reference is also made to the need to "Assist in strengthening the teaching of mathematics and science in the school system" (p. 59).

These two latter statements are very different in nature from each other: the first recognizes the necessity for a small but highly-skilled cadre of researchers, while the second takes cognizance of the fact that there must also be a commitment to ensuring that the school population as a whole receives adequate exposure to science. In a developing country with scarce resources, there is severe competition for the limited funds

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available. Thus, decisions in this context should be informed by an understanding of the range of possible purposes of science education in such a society.

It can be reasonably argued that all school children should be exposed to a broad-based science course with the aim of achieving a basic level of scientific literacy. Such a course might be integrated and issue-driven, and explore the science most relevant to everyday life. Ziman (1986) discusses this and points out that such a course might be *about* science rather than *of* science. A course of this nature could be designed to be completed in Grade nine (Form three) as many students do not stay in the school system beyond this grade.

Some students will, however, need to receive science instruction that is suited to further courses in technical fields, for example, those required for electrical and mechanical technicians, nurses, dental technicians and radiographers. In these cases, the need is for a more discipline-specific science background at a somewhat higher level. In general, the Caribbean Examinations Council's (CXC) General Proficiency Examinations would be of an appropriate standard and depth.

Compared with the numbers of technicians, a society will require fewer engineers (of all kinds), medical doctors, computer specialists, nuclear scientists, etc., but the minimum demand for entry into these professions is a university-level science background. Finally, there are the needs of the research profession to be satisfied. It might be hoped that the range of needs identified above might guide the allocation of resources between the primary, secondary and tertiary sectors of the education system.

Recent Jamaican government statistics (Planning Institute of Jamaica, 1989) state the numbers of students graduating with qualifications for certain science related occupations and show some disturbing trends. The reports make the following points:

(i) The number of nurses graduating each year declined by about 50% between 1985 and 1989. (Possibly the remuneration to be received after graduation is an important factor here).

(ii) There is a continuing shortage of trained personnel in the medical and dental technical areas.

(iii) The number of engineers graduating (about 50 a year) was far below the reported demand of about 90 to 125 a year.

(iv) Migration to North America represents a continuing and substantial loss of trained personnel which further reduces the numbers entering and remaining in the labour pool in Jamaica.

(v) Graduates in physics from the University of the West Indies (UWI) number about 15 a year, although greater numbers graduate with natural science degrees having completed some physics courses. Given that physics serves as a base for other disciplines, these low numbers are worrying and do not appear to allow for the satisfaction of the demands of industry, as well as supplying the education system with the graduates it needs for the teaching of this subject in Jamaican high schools.

While several factors might be contributing to the scarcities mentioned, it is reasonable to suggest that a major factor must be the inability of the education system to produce adequate numbers of students with the appropriate qualifications to be trained in these several different areas.

The data available in the reports published by the Government of Trinidad and Tobago (Central Statistical Office, 1989) are less precise. It is reported, however, that there may be a surplus of engineers and engineering technicians. It appears that the main area of shortage in Trinidad and Tobago may be in the nursing profession. There have been no regular reports of shortages of scientifically-trained personnel in Barbados.

Trends in Examination Results in Secondary Schools

If it is true that one of the reasons for inadequate numbers of entrants to, and graduates from, higher-level science courses is the failure, at lower levels, of students who may have wished to pursue a scientific career, then it would be useful to examine the trends in secondary school

examination results.

In the Caribbean, the first major external science examinations for school students are the regional CXC science examinations. These examinations are usually sat by students who have had five years of secondary level education, with the final two years specifically following the CXC syllabus in the particular subject. Prior to the introduction of the CXC single science syllabuses in 1985, Caribbean secondary school students were entered for the Ordinary (O') Level examinations administered by British Examination boards.

The examination boards do not present their results as passes or failures, but it is common to consider a General Proficiency Grade I or II (CXC) and Grade A, B or C (O' Level) as "passes". In order to assess trends, it is necessary to assume that there is an equivalence of Grades I and II with Grades A, B and C as was the intention when the CXC examinations were introduced. The work of Prime (1991) lends some support to a belief in this equivalence.

If a student obtains a Grade I or II in a subject in the CXC General Proficiency examination, or a Grade A, B or C in the O' Level examination he or she may progress to the Advanced (A') level examination in the subject. The A' Level examinations administered by the British examination boards, require two further years of study and prepare the students for entry to university.

The entry number, absolute number of passes and percentage pass rate vary from year to year as a result of factors peculiar to that year and cohort. Thus, firmer evidence of trends can be obtained if the results from several years are grouped and averaged. In the following analysis, the years 1982-1984, 1986-1988 and 1989-1991 are used as three groups of three years. The omission of 1985 can be justified as it was an atypical year in which the CXC single sciences were first examined. The results of this year are to some extent discontinuous with those of both the years preceding and those following it. A similar effect of the introduction of a new syllabus has been noted by Cox (1991).

Barbados, Jamaica, and Trinidad and Tobago between them provide over 80% of the candidates for the biology, chemistry and physics CXC examinations. Thus, the trends in these three territories dominate the statistics for the region. All three territories have had as government policy that, two years after the introduction of a new CXC syllabus it becomes compulsory in secondary schools in the territory. In Jamaica, compliance with this policy has been slow, and up to 1991 reasonable numbers of students were still being entered for British O' Level examinations. In 1985 and 1986, schools in Barbados, and Trinidad and Tobago could elect to enter their candidates for either examination. As a result of this situation, both CXC and O' Level results have to be taken into account for the period 1986-1991.

Table 1 summarizes the average entry, pass numbers and percentage pass rate per year for Barbados, Jamaica, and Trinidad and Tobago for the selected periods for CXC General O' Level.

Table 1
Average CXC General O' Level Results: Sciences

	Biology			Chemistry			Physics		
Barbados									
	E	P	%	E	P	%	E	P	%
1982-84	723	275	38.0	515	230	44.7	346	199	57.5
1986-88	767	321	41.8	540	307	56.8	409	185	45.3
1989-91	731	330	45.1	504	307	60.9	404	231	57.1
Av. Inc/Dec									
82/84 to 89/91	8 (1%)	55 (20%)		-11 (-2%)	77 (33%)		58 (17%)	32 (16%)	
Jamaica									
	Biology			Chemistry			Physics		
	E	P	%	E	P	%	E	P	%
1982-84	5204	1266	24.3	2639	1237	46.9	2015	890	44.2
1986-88	4204	1132	26.9	2584	1131	43.8	2244	710	31.6
1989-91	4073	1047	25.7	2637	1150	43.6	2477	808	32.6
Av. Inc/Dec									
82/84 to 89/91	-1131 (-22%)	-219 (-17%)		2 0%	-87 (-7%)		462 23%	-82 (-9%)	
Trinidad and Tobago									
	Biology			Chemistry			Physics		
	E	P	%	E	P	%	E	P	%
1982-84	5395	1510	28.0	4090	1475	36.1	2613	1037	39.7
1986-88	4292	1768	32.8	3321	1562	47.0	2642	1061	40.1
1989-91	4676	1865	39.9	3282	1699	51.8	2886	1320	45.7
Av. Inc/Dec									
82/84 to 89/91	-719 ((-13%)	355 (24%)		-808 (-20%)	224 (13%)		273 (10%)	283 (27%)	

Key:

E	-	Average Entry Number
P	-	Average Pass Number
%	-	Average Percentage Pass Rate
Av. Inc/Dec	-	Average increase/decrease of entries and pass numbers between 1982-84 and 1989-91. (percentage increase/decrease)

(Sources: Records of the Caribbean Examinations Council (1985, 1986, 1987, 1988, 1989, 1990, 1991) and the Cambridge Local Examinations Syndicate (1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991).

(Some duplication of entry may have occurred, but there is no evidence of large scale double entering of candidates in these subjects).

The figures presented in Table 1 show the following:

(i) In Barbados, between 1982-84 and 1989-91, entries have increased by 17% in physics, while remaining essentially stable in biology and chemistry. Pass numbers are up by 20% in biology, by 33% in chemistry and by 16% in physics.

(ii) In Jamaica, over the same period, the biology entry numbers show a decrease of 22%, entries to chemistry are unchanged, and the entry numbers to physics show an average increase of 23%. The average yearly pass numbers, however, show a decline of 17% in biology, and small declines of 7% in chemistry and 9% in physics.

(iii) In Trinidad and Tobago, although the entry numbers in biology and chemistry declined by 13% and 20% respectively between 1982-84 and 1989-91 (the age cohort declined, rather surprisingly, by about 16% over this time), the pass numbers rose by 24% in biology and 15% in chemistry. An average increase in the entry number of 10% in physics was accompanied by an increase in the pass number of 27%.

Generally, the percentage pass rates are cause for concern. There is a considerable commitment of extra resources to science education compared with other disciplines (mainly in the capital and recurrent provision for laboratories and technicians), and yet the pass rates in biology average barely over 30%, in chemistry about 45%, and in physics just over 40% in the three territories. These figures suggest a relatively low efficiency in the education systems of the three territories (with Barbados being rather more efficient and Jamaica rather less). Whether the quality and quantity of instruction for these examinations, earlier experiences in school science, the level of practical provision or other factors may correlate with these results are questions for further research --some work is in progress into some of the factors that may influence Jamaican and Trinidadian students' examination performance in physics (Whitely, 1993).

It is worth noting the very different pass rates in biology compared with those of physics and chemistry in the three territories. The total numbers entered and the total number of passes obtained for the years under review are displayed in Table 2.

Table 2

Total Entries and Passes 1982-1991 (excluding 1985) Barbados, Jamaica, and Trinidad and Tobago

	Entered	Passed	%
Biology	30,065	9514	31.6
Chemistry	20,112	8891	44.2
Physics	16,036	6441	40.2

The lower pass rate in biology could be the result of a range of factors that may include:

(i) the nature and scope of the CXC biology syllabus;

(ii) the emphases in the examinations set to test this syllabus; and

(iii) the quality of the candidate population in biology compared with those in physics and chemistry.

The importance accorded to the subjects may also lead to variable effort by students, with more or less time being expended in the three subjects.

Perhaps this lower pass rate in biology can be justified on the grounds that "everyone needs to know (or at least have been exposed to) some biology" but it seems that a proportion of the biology candidates might better have been encouraged to make an alternative choice earlier in their school career. There is anecdotal evidence available to the writer that some of the candidates who pursue the biology course are those who are not allowed to take physics or chemistry, and for whom the entry into at least one science subject is compulsory as school policy. This policy seems to have value, but perhaps an integrated science course leading to a broader scientific literacy might be more appropriate for these students. The CXC Integrated Science (Single Award) has the potential to fill this need, although the number of candidates currently being entered remains relatively low (a total of 2426 candidates in 1992 in the three territories), as this syllabus is commonly held to be only suitable for the 'less able'.

It is important to also consider changes in the pass numbers, rather than merely in the percentage pass rate as, ultimately, it is the absolute number of students with these qualifications which is important. Further, the percentage pass rate can vary widely due to changes in the entry numbers which depend, among other factors, on the 'screening' policies of schools. A fairer comparison of the three territories can be made by taking into account the very different sizes of their total age cohorts and the changes in those age cohorts. These were in 1990, for example, approximately, Barbados--4,700 (Registration Office, 1989), Jamaica--56,000 (Department of Statistics, 1984, 1987, 1990), and Trinidad and Tobago--21,000 (Central Statistical Office, 1987, 1990).

The following proportions are obtained using the relevant figures for the age cohorts--Table 3.

Table 3

Proportion of Age Cohort Obtaining a *Pass* Grade

		1982-84	1989-91
Barbados	Biology	1 in 21	1 in 14
	Chemistry	1 in 25	1 in 15
	Physics	1 in 29	1 in 20
Jamaica	Biology	1 in 41	1 in 53
	Chemistry	1 in 42	1 in 49
	Physics	1 in 58	1 in 69
Trinidad and Tobago	Biology	1 in 17	1 in 11
	Chemistry	1 in 17	1 in 12
	Physics	1 in 24	1 in 16
Age Cohorts	Barbados	5,750	4,700
	Jamaica	52,000	56,000
	Trinidad and Tobago	25,000	21,000

The difference in the level of performance in the three territories is now readily apparent. In Jamaica, a smaller proportion of the age cohort was obtaining pass grades in the three subjects at the end of the 1980s than at the beginning. By contrast, in Barbados and Trinidad and Tobago, there has been an improvement in the performance in all three sciences. The extremely low proportion of the age cohort obtaining a pass grade in physics in Jamaica must be of particular concern to those involved with science education in Jamaica, given the previously mentioned importance of physics in a range of occupations and as a base for further study in other disciplines.

The results in the Cambridge A'Level science examinations in the three countries are now presented--Table 4.

Table 4

Average Cambridge A'Level Results: Science

Barbados									
	Biology/Zoology			Chemistry			Physics		
	E	P	%	E	P	%	E	P	%
1982-84	110	52	47.3	135	67	49.6	102	62	60.8
1986-88	121	59	48.5	163	93	57.1	118	84	71.2
1989-91	138	69	50.5	187	124	66.3	140	95	67.9
Av. Inc/Dec									
82/84 to 89/91	28 (25%)	17 (33%)		52 (39%)	57 (85%)		38 (37%)	33 (53%)	
Jamaica									
	Biology/Zoology			Chemistry			Physics		
	E	P	%	E	P	%	E	P	%
1982-84	353	172	48.6	490	230	47.0	352	157	44.6
1986-88	342	154	45.0	512	238	46.5	352	138	39.2
1989-91	314	129	41.1	501	264	52.7	340	136	41.6
Av.Inc/Dec									
82/84 to 89/91	-39 (-11%)	-43 (-25%)		11 (2%)	34 (15%)		-12 (-3%)	-21 (-15%)	
Trinidad and Tobago									
	Biology/Zoology			Chemistry			Physics		
	E	P	%	E	P	%	E	P	%
1982-84	351	170	48.4	664	361	54.4	530	277	52.3
1984-88	441	291	66.0	759	519	68.4	581	380	65.4
1989-91	537	342	63.7	856	629	73.5	599	376	62.8
Av.Inc/Dec									
82/84 to 89/91	186 (53%)	172 (101%)		192 (29%)	268 (74%)		69 (13%)	99 (36%)	

Key:

E	-	Average Entry Number
P	-	Average Pass Number
%	-	Average Percentage pass rate
Av. Inc/Dec	-	Average Increase/Decrease of entries and pass numbers between 1982-84 and 1989-91. (percentage increase/decrease).

The figures in Table 4 show the following:

(i) In Barbados, between 1982-84 and 1989-91, entries and pass numbers in the biology A'Level examinations both increased by 25%, chemistry average entry numbers were up by 39% with pass numbers up by 85%, and the physics 37% increase in average entry numbers were accompanied by a 53% increase in pass numbers.

(ii) In Jamaica, biology A'Level entry numbers decreased by 11% over the selected period, while chemistry and physics figures were stable. The pass numbers for biology and physics decreased in Jamaica--by 25% in biology and by 13% in physics. Chemistry pass numbers rose by about 15% over the period.

(iii) In Trinidad and Tobago, entry numbers rose by 53% in biology, by 29% in chemistry and by 13% in physics. Pass numbers rose at greater rates--by 101% in biology, by 74% in chemistry and by 35% in physics.

The position may be assessed by comparing the average pass numbers for 1989-1991 for the three countries--Table 5.

Table 5

Average Pass Numbers, 1989 - 1991
Cambridge A'Level Examinations in Science

	Barbados	Jamaica	Trinidad & Tobago
Physics	95	136	376
Chemistry	124	264	629
Biology/Zoology (combined)	69	129	342

The relative sizes of the age cohort are of the order of 1:12:4.5 Barbados:Jamaica:Trinidad and Tobago, so the pass numbers might have been expected to be in a similar ratio. Although the Barbados and Trinidad and Tobago numbers are in the ratio of 1 to 4 or 5, the Jamaican results bear no such relation to those of the other territories. Such a comparison does not give an indication of the absolute efficiency of the two better territories, but it does suggest that Jamaica has a particular problem.

Summary of CXC/O'Level and A'Level Results

The figures presented suggest that a significantly lower proportion of the age cohort have been reaching the CXC General Proficiency or O'Level standard in the three sciences in Jamaica than in Barbados or Trinidad and Tobago. In absolute terms, in Jamaica the numbers appear to be continuing to decline in biology, while the decline may have moderated in physics and chemistry. These trends have clear implications for the numbers of students who might take the A'Level sciences and move on to University-level science. The figures at A'Level suggest further that, whereas about one-third of the successful candidates in CXC physics and chemistry in Trinidad and Tobago move on to obtain at least the lowest passing grade at A'Level, and up to two-fifths do likewise in Barbados, only one-fifth of the successful CXC candidates in Jamaica do so. The differences in examination results between the territories suggest factors at work which should be identified, and enhanced or addressed as necessary. This should allow greater numbers of students to achieve the standards needed for entry into the range of scientifically-oriented careers which are important for the progress of the region. Some possible factors

are discussed later in this paper.

Trends in the Numbers of UWI Science Graduates

Examination of the statistics of the number of graduates from the University of the West Indies (UWI) with science-related degrees (UWI, 1991) reveals trends which have some correspondence with the trends already identified in the secondary level results. Table 6 shows the changes in the average number of science-based degrees awarded each year at the Cave Hill (Barbados), Mona (Jamaica) and St. Augustine (Trinidad) campuses of UWI between 1982 and 1990.

Table 6

Average Graduates Per Year - UWI

	Faculty of Agriculture	Faculty of Engineering	Faculty of Medicine	Faculty of Natural Sciences		
	SA	SA	M	CH	M	SA
1982-84	67	140	97	46	171	77
1985-87	60	141	107	53	187	123
1988-90	53	157	99	67	183	149

Key:
M - Mona
SA - St. Augustine
CH _ Cave Hill

There has been an increase in Natural Science graduates during the period at all three campuses, but the percentage increase is clearly greatest in Trinidad (94%), compared with Barbados (46%) and Jamaica (5%). Typically, 83% of registrations in the Natural Science Faculty at Mona are Jamaican students, 99% of the registrations at St. Augustine are Trinidadians, and 60-70% of the registrations at Cave Hill are Barbadians. If the assumption is made that the campuses primarily serve to provide manpower for the societies in which they are situated, then the slow growth in Jamaica could be considered worrying.

Over this time, the output from the Faculty of Medicine has been essentially constant although one expects that the commencement of teaching at the Mt. Hope Complex in Trinidad will lead to higher numbers graduating from this faculty in the future. In 1990, the degrees awarded in the medical faculty included degrees to 42 Jamaican students, 7 Barbadian students and 31 students from Trinidad and Tobago. It has been suggested that an over-supply of doctors may result in the coming years in Trinidad and Tobago. In Jamaica, however, as a consequence of emigration and the long-standing island-wide deficit in the number of doctors available, the supply has yet to match the demand.

The Faculty of Engineering has experienced a small increase (12%) in the average yearly number of graduates between 1982-84 and 1988-90. The published figures for engineering graduates in 1990 show that 93 students were from Trinidad and Tobago, 37 from Jamaica and 15 from Barbados. The 1991-1992 registration figures in this faculty of 347 Trinidadian students, 148 Jamaican students and 45 Barbadian students, suggest that these differences in the numbers of graduates among Trinidad and Tobago, Jamaica and Barbados will be maintained.

The number graduating yearly from the Faculty of Agriculture appears to be gradually declining. Students from Trinidad and Tobago constitute approximately two-thirds of the number graduating, with Jamaican students comprising about one-third of the graduates.

The reported shortages of university qualified personnel with science backgrounds in several sectors of the Jamaican society are likely to continue, unless an expansion in the numbers of Jamaican science and engineering graduates can be achieved.

Possible Factors Affecting Examination Results

Some work was done in the 1970s in the Caribbean which sought, amongst other aims, to identify the factors leading to academic success as measured by the results of external examinations Leo-Rhynie (1976) and Hamilton (1981). These studies investigated a range of independent variables including early educational experiences, the school's resources both in terms of materials and the teachers, the home environment and certain measures of the students' cognitive functioning. The analyses highlighted the importance of the school environment and O' Level performance as factors that determined performance at A'Level. No such studies have been reported in the Caribbean since the introduction of the CXC single science syllabuses. In the discussion below, possible factors are grouped under finance-related, level of teacher support, and language and science learning.

a) **Finance-Related Factors**

In the mid-1980s, the budget allowance (per capita) for education in Barbados was about US$300, in Jamaica US$45 and in Trinidad and Tobago US$270. As a consequence of these differences, there are considerable differences in the salaries of school teachers in Jamaica compared with those in Barbados, and Trinidad and Tobago. The salary scales are probably the major cause of the great difficulty that schools in Jamaica have reported in recruiting qualified science teachers. There are reports of classes being without teachers for considerable periods of time (as the teacher often leaves with little notice), of classes which are too large for effective teaching, and of teachers being asked to teach at levels which are above the level of their real competence. It appears that only considerable increases in the remuneration of teachers will lead to any significant improvement. The recent (end of 1992) considerably improved contract signed by the Jamaican teachers' unions and the government may go some way in alleviating the problem, or a least prevent the problem from becoming worse.

By contrast, the relative affluence and economic stability of the other two territories has led to a reasonably stable teaching population. As Cox (1991) has pointed out, there seems to be, not surprisingly, a clear link

between the economic situation in a country and the quality of the education that it is able to provide. A further consequence is that the science teachers in Forms 1-3 in Jamaican high schools may generally have lower qualifications than their Trinidadian and Barbadian counterparts, that is, relatively few of such teachers may be science graduates, and of those only a proportion may have teacher training. Some current work (Whiteley, 1993) is also investigating the possible influence of the qualifications and experience of lower school science teachers on students' performance in the CXC physics examinations. It is generally held, and is supported by the author's experience, that the content base of many of the lower school science teachers in Jamaican secondary schools is not at an adequate level and leads to less efficient teaching.

Along with the inability to retain or recruit suitable teachers, schools in Jamaica have also found it difficult, as a consequence of inadequate government subventions, to maintain the quality of laboratory provision at the level needed. The cost of foreign-made equipment is often prohibitive (particularly in physics) and many schools have found it difficult to cover even the recurrent costs of science practical work. Library provision of science books and magazines may also be at a lower level in Jamaica.

b) **Levels of Teacher Support**

Trinidad and Tobago has an active science teachers' association (Association for Science Education of Trinidad and Tobago--ASETT) which from time to time, along with the Ministry of Education, organizes workshops and seminars for the in-service training of teachers. In recent years, the equivalent association in Jamaica (Association of Science Teachers of Jamaica--A.S.T.J.) has not been as active as in the past. Besides organizing specific workshops, the Ministries of Education in Trinidad and Tobago and Barbados appear to exert a much greater degree of centralized control than the Ministry of Education achieves in Jamaica. This control may lead to better dissemination of information relating to new curricula and teaching methodologies, to greater guidance as to the provision of appropriate practical work and, in general, a better two-way flow of information. Further, the Ministry of Education in

Trinidad and Tobago introduced science into the Common Entrance Examination some years ago, thereby strongly influencing the teaching of science in primary schools. It is regularly reported that an emphasis on the 'Common Entrance subjects' in Jamaican primary schools reduces or eliminates the teaching of science as it is not a component of the Jamaican Common Entrance Examination.

c) Language and Science Learning

Another factor contributing to the differences in performance in science examinations may be a link between literacy rates in the territories and the performance in science. Research elsewhere supports a link between proficiency in language and performance in science (Bell & Baker, 1982; Osborne & Freyberg, 1985, Page, 1971 (cited in Carre, 1981); Richards, 1978). Local work suggests that a similar link may exist in the Caribbean. Glasgow notes that scientific literacy and scientific achievement are not synonymous, but one may be conducive to the other. Glasgow cites the work of Douglas (1978) who isolated reading as one of the factors contributing to learning difficulties associated with O'Level biology topics, and also mentions the work of Steward (1979) that demonstrated that 'relatively simple' non-technical words (e.g., average, rate, effect, incident) were not understood by over 20% of a sample of teacher trainees.

Glasgow (1981) also discusses the particular difficulties that may exist in a bidialectal society such as Jamaica. She cites work in Nigeria (Ehindero, 1980) which suggests that teaching science to bilingual primary school children in their first language led to a higher level of cognitive development and a significantly better performance on concepts requiring the use of higher level skills. In a bidialectal situation, as in Jamaica (where the natural language differs from the *official* language but there is some degree of overlap in vocabulary and grammar), the difficulties can reasonably be expected to be greater.

All of the above factors may be contributing, in a complex manner, to the demonstrated differences in science examinations' results between Jamaica on the one hand, and Barbados and Trinidad and Tobago on the other. There seem to be several areas which might be the subject of

further research. The following might be investigated:

(i) the factors influencing performance in science examinations at both CXC and A'Level;

(ii) the teacher education and training programmes in science; and

(iii) relationships, if any, between the annual expenditure on science education and the results obtained.

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