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**THE ACCESSIBILITY OF SCIENCE INSTRUCTIONS TO JAMAICAN STUDENTS**

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## ABSTRACT

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The debates about the importance of the sociocultural and sociolinguistic influences that affect science textbooks and classroom instructions have been the focus of much attention by theorists and constructivist thinkers for many decades. Such debates are particularly salient in the context of Jamaica, where the language of instruction is Jamaican Standard English (JSE) and many of the students are first language speakers of Jamaican Creole (JC). Against a background of the Creole-speaking environment in Jamaica, this research investigates the circumstances in which Jamaican bilingual science learners might be at an advantage or at a disadvantage in understanding science instructions.

Participants were selected from five school types in Jamaica: junior high, private, technical, traditional and upgraded secondary. Data concerning students' and teachers' attitudes and opinions were collected through interviews and questionnaires. More detailed linguistic information was collected through Cloze procedures, discussion tasks and a social semiotic analysis of the textbook studied. A wide literature was reviewed concerning the structure of scientific language, the Jamaican linguistic situation and school science textbooks.

The findings provided evidence for four main assertions which arose from the research. First, the findings raised some salient considerations in terms of the extent to which science textbooks and classroom instructions are accessible, especially to students in the junior high, technical high and upgraded high schools. Secondly, even students who were proficient in JSE and were learning science in English experienced difficulties in dealing with the specialist vocabulary and in coping with the language demands and assumptions made by science teachers and writers of curriculum materials. Thirdly, the results provided substantial evidence which suggested that teachers and students held ambivalent attitudes to language use in science classrooms across the five school types investigated in the study. Fourthly, teachers and students were united in the belief that the language of science instructions posed significant barriers to the learning of science.

## DECLARATION AND WORD COUNT

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I hereby declare that, except where explicit attribution is made, the work presented in this thesis is entirely my own.

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Wilton George Lodge  
April 2018

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This thesis is dedicated to all those who are concerned about the future of science education in Jamaica.

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## CHAPTER 1

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### RESEARCH CONTEXT

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This chapter provides a discussion of the research context and my interest in this specific area. The discussion on science instructions in Jamaica addresses issues of general importance, including the challenges of using non-standard language in the description and practice of science. The chapter outlines the importance of school science textbooks in the teaching and learning process and discusses why they play such a key role in the Jamaican science classroom. Following this, I provide a rationale for the need for research exploring the accessibility of science instructions in the Jamaican context.

#### **1.1 Introduction**

In Jamaica, there is a concern over the paucity of workers required for technological development and advancement in science-related fields (Carpio & Bench, 2015). Invariably, students' generally poor performance in the Caribbean Secondary Education Certificate (CSEC) science examination taken at the terminal point of their high school career appears to justify this concern (Thomas, 2016). This situation, and the context from which it has emerged, has generated various theories that might explain the prevailing academic underachievement of Jamaican students in science when compared with their counterparts in the rest of the English-speaking Caribbean. According to a release from the Jamaica's Ministry of Education (2016), there was a seven-point decline in performance on Integrated Science in 2016 when compared with that of 2015, 37% of entries achieved acceptable grades compared with 44% in 2015. Of the candidates from Barbados, Trinidad and Tobago and Guyana who wrote the science examination in 2016, the percentage obtaining grades one to three were 66, 56 and 48% respectively (CXC, 2016).

Within this context, scholars in the field have criticised the uncreative and unimaginative didactic approach in science teaching (Berry, 2012); others have expressed concerns about the pervasive existence of inadequately trained and under-qualified science teachers at all levels in Jamaican schools and the lack of scientific laboratory resources (Thomas & Wionczek, 2013). Still others implicate students' lack of interest in science, the lack of conceptual understanding of scientific ideas and the obfuscating language barriers that affect students'

ability to access examination items in mathematics and science (Beaumont-Walters & Soyibo, 2001).

Within the last 15 years or so, educators have become increasingly interested in understanding the nature and relationships of discursive practices in science classrooms (Brown et al, 2005; Kelly, 2007). Broadly speaking, research within this perspective includes considerations of the sociocultural and sociolinguistic influences that affect students' thinking and meaning making. What has also emerged from these studies is the value of viewing science learning as an intercultural process in which students and teachers negotiate the boundaries of ethnicity, culture, language and subject matter to overcome the traditional inequalities that persist in science classrooms. Such research is particularly salient in the context of Jamaica and addresses many issues of general importance for raising awareness of the various linguistic dimensions of science-related fields and to promote a formulation of classroom practices that are both academically rigorous and equitable for students.

Elsewhere, there has been a strong interest by researchers in the role of language in the complex interactions related to science teaching and learning. In this respect, researchers such as Jay Lemke have drawn specific attention to the intrinsic relationship between language and science education, and the important role that language plays in mediating thoughts between learners and teachers (Lemke, 1990). The language of science lessons is the medium that enables learners to explore ideas, clarify the meaning of technical terms and new concepts, develop new understanding and vocabulary, and communicate methods of reasoning and inquiry. Yet, there has been a significant body of research that has consistently highlighted language as one of the major difficulties students face in science learning (Driver et al, 2000; Yore et al, 2003; Soyibo, 1996; Tan, 2011). These studies indicate that even students whose first language is English and are learning science-related subjects in English experience difficulties in dealing with specialist vocabulary and in coping with the language demands and assumptions made by teachers and writers of curriculum materials (Lee et al 2013; Wellington & Osborne, 2001).

During the twentieth century, international communication has shifted from a plural use of several languages to a clear pre-eminence of English, including in the field of science and technology. Indeed, many research studies focusing on international periodical publications have reported that well over 90% of articles in the natural sciences are now written in English

(see, for example, Tardy, 2004). Alastair Pennycooke (2014) argues that it is the discourse of English as an international language that has primarily justified the present dominance of English. A similar perspective is expressed by Robert Phillipson and Tove Skutnabb-Kangas (2013) who suggest that there is a structure of inequality between English and other languages which is justified and reinforced by international power politics, exploiting development aid and worldwide English language teaching.

This shift towards English has created a hegemonic influence not only in scientific publications and academic exchanges, but also in science education, including classroom discourse. In this formulation, English hegemony can be seen as a source of inequality, injustice and discrimination in intercultural and international communication (Phillipson & Skutnabb-Kangas, 2013). Scholars of non-English speaking countries encounter difficulties in getting their research accepted, not necessarily because of the quality of their work, but because of their poor English Language proficiency (Huang, 2010). In such a system, it is reasonable to argue that international journals and scientific discourse benefit scholars who are native speakers of English.

## **1.2 Jamaica's educational system – an historical perspective**

A study of the history of education in Jamaica in the context of its colonial past is crucial to understanding the current situation in Jamaican schools. Thompson et al (2011) make much the same point when they argue that “to discuss education in the Caribbean without reference to the influence of colonialism is to deny the ubiquitous and co-dependent relationship of the coloniser and the colonised” (p. 61). Moreover, scholars in the field of education, such as Miller (1995), have established a strong correlation between the colonial forces and the innumerable problems in the present education system. The roots of such concerns can be found within the country's long legacy of colonialism extending 300 years in length before independence. In the view of the former Jamaican prime minister, Michael Manley, “Jamaica was the meeting place of two expropriate populations: the British uprooting himself in search of quick wealth through sugar; and the African uprooted by force from his environment to supply slave labour upon which his owner's dream of wealth [is] depended” (Manley, 1975, p. 12).

For this thesis and to further reflect on education within the perspective of colonialism, a working definition is needed to bring transparency to the ideologies that mediate the

discourse. Colonialism within this context is regarded as the imposition of economic and political relationships within a society by another country (Thompson et al, 2011). Historically, this has often involved killing or subjugating the indigenous population. A colonial power must control populations with very different social-systems from its own, which are distributed at great distances from metropolitan and territorial capitals and which, in the case of Jamaica, often manifested very low levels of social and economic differentiation.

In similar vein, Asante (2006) notes that “colonialism seeks to impose the will of one people on another and to use the resources of the imposed people for the benefit of the imposer” (p. x). This must inevitably lead to a situation of dominance and dependency which will systematically subordinate those governed by it to the imported culture in social, economic and political life. Nothing is sacred in such a system as it powers its way toward the extinction of the wills of the imposed upon, with one objective in mind: the ultimate subjection of the will to resist. An effective system of colonialism reduces the imposed upon to a shell of a human who is incapable of thinking in a subjective way of his or her own interest. In everything the person becomes like the imposer; thus, in desires, wishes, visions, purposes, styles, structures, values and especially the values of education, the person operates against his or her own interest.

As a by-product of colonisation, the colonising nation implements its own form of schooling within their colonies to suit their purposes. These purposes were not only achieved through physical control but also through mental control. This mental control is implemented through a central intellectual location - the school system or what Louis Althusser refers to as ‘the ideological state apparatus’. Kelly and Altbach (1984) noted that “colonial schools sought to extend foreign domination and economic exploitation of the colony” (p. 1). Education, in this sense, was “directed at absorption into the metropole and not separate and dependent on the development of the colonised in their own society and culture” (Kelly & Altbach, 1984, p. 4). They concluded that the process was an attempt to strip the colonised people away from their indigenous learning structures and draw them towards the structures of the colonisers. In the case of Jamaica, this was effectively done by the British.

The education system and its administration were fashioned after the British system and was carefully structured to perpetuate a culture of underdevelopment and dependency. In the sense, colonial schooling was education for subordination, exploitation, the creation of

'mental' confusion and the development of 'underdevelopment'. Walter Rodney, a renowned Caribbean scholar, in his ground-breaking book *How Europe Underdeveloped Africa* (1972) makes a polemical but convincing argument on colonial schooling in the British West Indies. His jeremiad asserts that the system of education was designed by the British colonisers to impose upon the dominantly black population, the white man's mythical, racial superiority and the black man's inferiority. Rodney argues that whatever black people were taught about themselves was designed to enable them to internalise their inferiority and recognise the white man as their 'saviour'. He may indeed have a point since there is a large body of research which suggests that such ideologies have inspired a grim fatalism in some Jamaicans that have seen them stuck in what Stuart Hall refers to as the "colonial mentality" (see, for example, Wilder, 2015). Such colonial mentality is reinforced through negative images in literature, film, the press and other media, and over time black people have come to accept the ideologies, beliefs and imagery about white superiority and their own alleged inferiority.

### *1.2.1 Education pre-and post-emancipation*

Before the Act of Emancipation went into effect in 1834, there appears to have been no formal provision of education for the slaves, except perhaps that provided by various non-conformist missionaries to convert the slaves to Christianity, conversion which was accompanied by a fundamental education in reading and, to a lesser extent, writing and arithmetic, which to facilitate conversion and retention of the new religion (Dunkley, 2011; Whyte, 1977). On the eve of emancipation, only 36 schools were reported as being in existence, and these were primarily owned by the religious denominations and, in several instances, by private, charitable trusts (Eisner, 1961). The affluent section of the population – the wealthiest planters and the more prominent of the lawyers and businessmen, sent their children (and, occasionally, their illegitimate children) to Public Schools and Oxbridge in England. There were, for example, 268 Jamaicans registered at Oxford between 1689 and 1885 (see Cundall, 1911). Notably, those who were in control of the island's government through the Assembly were those who sent their children to be educated in England. Consequently, their interest in supporting education in the island was therefore negligible. Such training as the slaves needed to be efficient field workers or carpenters, joiners, coopers and smiths, the few skills necessary to the functioning of the estate, could be learned through apprenticeship, independent of the slave's ability to read or write.



Many white people, however, could not afford private tuition at home or schooling abroad for their children and there are reports of occasional free schools kept usually by clergymen and catering mainly to this group (Gordon, 1963). The curriculum in the free schools was largely based on that offered by similar schools in Great Britain and was intended “to offer a classical education to young gentlemen so that they would be properly fitted to take their place in society” (London, 1995, p. 99).

Education was seen by the colonisers as an important way to integrate ex-slaves into the economy (Dunkley, 2011). Consequently, a national system of education began in the 1860s following the transfer of control of the island’s internal government from the local Jamaican Assembly to the British parliament in the wake of wide-spread unrest. The Anglican Church was given a key role: that of developing a system of elementary education that moulded Jamaican children into civilised Christians and model British colonials, proud of the heritage of the supposed motherland and delighted to share in the glory and civilisation that the British Empire bestowed.

On the surface, the notion of providing education for the disenfranchised Jamaican population appeared to be laudable, as schooling emphasised skills that would prepare children for eventual employment as estate workers. But the result from a large body of work produced by scholars such as Shirley C. Gordon, M. K. Bacchus, and Howard Fergus has sided with the view that the focus of education policy in Jamaica, as well as in the other West Indian islands, was geared towards keeping the black population on the lowest rung of the employment and social ladders while they remained subservient to their white colonial masters. London (1995) offers a theoretical framework for this assessment. He notes that the major focus of colonial education was to “teach students those values, attitudes and beliefs which were to make them hard working and responsible hewers of wood and drawers of water” (p. 99). Inherently, the education system was largely based on British values and consciousness and promoted docility, subservience, deference and reverence for all things British (London, 1995). London’s view in this respect, is reinforced by Thompson et al (2011) when they suggested that “formal education in most of the West Indies originated and found expression within the general framework of British colonialism” (p. 62).

By the end of the nineteenth century there was a burgeoning cry for the state to take more responsibility for the education of the young people in the colonies. These demands were

strengthened by the reality that traditional sources of missionary funds from overseas were no longer as abundant. The burden of constructing and maintaining schools and churches fell increasingly upon peasants' parents and church congregations. Although the system whereby the churches underwrote education in Jamaica eminently suited the colonial administration, at the end of the nineteenth century education took on a new dimension outside its traditional moral and spiritual focus. Education was now being framed in terms of moral and intellectual improvement of the people (Miller, 1995).

During the colonial epoch, secular schooling emphasised skills that would prepare children for eventual employment as estate workers. The primary concern was, less religious training and more with the task of obtaining functional knowledge for life after school. Thus, the elementary curriculum focused on reading, writing, and arithmetic with some religious training and occasional geography and history instruction. In addition, boys were trained in agriculture and other manual arts, and girls received lessons in sewing and domestic science. It was considered important to teach the swarthy descendants of the slaves an appreciation for the noble virtues and skills of agricultural work (Rodney, 1972). This view was fully endorsed by the 1898 Education Commission, which, starting from a racist position, stated that, among other things, the education system should aim to give fundamental manual and agricultural instructions in order that scholars could earn their living and discharge their duties as citizens. Moreover, the Lumb Report of the same year, cited in Gordon (1963), also recommended that boys and girls should be taught agriculture science "in such a manner as to overcome the prevalent distaste for these pursuits so essential to the economic standards of Jamaica and its citizens" (p. 128). Such recommendations, however, were strongly rejected by the rising black middle-class intelligentsia, who saw this as part of a programme defining the 'correct attitudes' and 'natural place' which Europeans thought fit for the natives. Consequently, the resistance against agricultural education was one of the most bitter struggles waged by anti-colonist Jamaicans, and helped heighten consciousness at all levels of Jamaican society, regarding the fundamentally exploitative and racist nature of colonialism.

Despite these oppositions, however, the colonial administration continued to ruthlessly pursue this policy of inferior education to the largely black population for what appears to be selfish elitist reasons. They contended that agricultural education, if properly conducted,

would instil the discipline and duty of honest work, considered so vital not just for economic growth, but to civilisation itself. In 1899, Colonial Secretary Joseph Chamberlain issued an order to the West Indian governments instructing them to institute agricultural education, and to transfer a considerable portion of the funds allocated for general education to agricultural education. But, by the early 1900s, a large majority of young black people had developed a dislike for agricultural enterprise and were moving from the countryside to cities and towns to take up 'office work'. Said the Colonial Standard in 1891:

In this country [Jamaica] there unfortunately exists a strong antipathy to manual labour. An industrious, respectable yeoman or small settler in Manchester or St Elizabeth sends his sons to school and youngsters, have received a smattering of learning, looks down with scorn on employment involving manual labour, and leads the life of idleness which is too often the dismal prelude to a career of criminality and vice. (p. 2)

The above narrative raises an important question: Why would an island of agriculturalists reject education which was supposedly intended to raise the level of agriculture? It would be reasonable to assume that these young people were not rejecting agriculture education per se, but a rejection of the broader ideology of what 'agricultural' education implies. Thus, it was a repudiation of the false view that black people were of lower intelligence and, therefore, could not benefit from academic education. Moreover, such policies were perceived by the mainly Afrocentric population as an attempt by the colonial administration to keep them in an inferior position and to hamper their economic and political advancement. It is in this context that agricultural education revealed itself as an exercise in deception.

### *1.2.2 Jamaica Schools Commission*

In 1879, a law was passed leading to the establishment of the Jamaica Schools Commission. This was the official body that governed and controlled the system of secondary education which evolved in Jamaica towards the end of the nineteenth century (King, 1987). The commission was authorised to "reorganise the endowments of charity schools established for the education of poor whites during the period of slavery" (Miller, 1987, p. 110) and to facilitate the establishment of a high school system. Development of the secondary system meant that those institutions who were being given assistance to provide elementary education would be given funding to offer secondary schooling (Whyte, 1977). Ruby King

(1998) argues that the formalisation of Jamaica's secondary education was considered "a direct response to the ruling class concern that the education of middle and upper-class children should keep pace with the education being provided for working-class children in the elementary schools. Secondary education was exclusively for children in the higher socio-economic classes. This meant that lower-class children, continued to find it difficult to attend secondary schools until the passing of the Secondary Education Act in 1892. The Act of 1892 allowed for the granting of scholarships to the most promising students from the elementary schools to further their education at the secondary-level (Bacchus, 1994). This provided some hope for upward mobility among children of the labouring classes. It may not be amiss, however, to point out that the elitists were anxious to ensure that the numbers from the lower class who would rise up the social ladder by means of acquiring a good secondary education was very restricted.

### *1.2.3 Teacher education*

Prior to the 19<sup>th</sup> century there were several attempts at establishing teacher training in the English-speaking Caribbean (Miller, 1995). During this early period teacher training was provided mainly through what constituted embryonic teachers' colleges and was aimed at teachers of elementary schools. Many of those who established the colleges saw the new teachers as akin to Christian missionaries, and were the main cogs in the dissemination of religious instructions to the younger generations of the colony<sup>1</sup>. Consequently, much of the early training was dogged with religious controversy. Almost all the colleges were residential and conditions, especially for women, were poor (Bacchus, 1994).

According to Miller (1995) teacher training activities in Jamaica were informed by the following concerns:

- A greater realisation of the importance of teacher training to the development of the colonies.
- The need to address the teacher education curriculum.

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<sup>1</sup> All but five of these early colleges were associated with the Church of England; of the five, two were set up by Congregationalists and three by the non-denominational British Society (for a more extensive discussion see Whyte, 1977).

- An assumption that a regional effort in improving teacher education would be superior to efforts by individual territories.

The drive to improve quality in teacher education is reflected in the establishment of the Mico College<sup>2</sup> in Jamaica in 1836, an institution which as the distinction of being the oldest teacher-training institution in the Western Hemisphere as well as the sole surviving normal school from the post-emancipation period in the Caribbean. Teacher education in Jamaica followed the identical pattern of the other Anglophone countries. Miller (1995, p. 26) offers a helpful summary of the major tenets of teacher education in Jamaica during the post-emancipation period:

- Indigenous teacher training capacity existed only for elementary school teachers. Secondary school teachers, when they received training, were trained abroad.
- The brightest and most intellectually able elementary school students were recruited as pupil teachers in the elementary schools. They received some in-service orientation from head-teachers of the schools employing them. Most of the instruction they received, however, was to improve their knowledge of content.
- A full-time programme of teacher education in college varied between two and three years in different periods in some countries. The trainees had admitted to college has invariably taught for some years before entry. As such they had been pre-trained teachers, and their training was coming after initiation into the profession. The teachers' colleges were often regarded as parallel and inferior form of secondary education. Teacher education at the teachers' college was conceived of as terminal, with the trained teacher not needing or requiring further education.

#### 1.2.4 *The pupil-teacher system*

An analysis of the education systems in the English-speaking Caribbean during and after colonialism would be incomplete without a more sophisticated examination of the arguments surrounding the establishment of the pupil-teacher education system. The general rubric of the pupil-teacher system enables me to situate more precisely the kind of impact that the

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<sup>2</sup> Mico College was founded in 1836 by the eminent British abolitionist Sir Thomas Fowell Buxton (1786-1845), using funds that were originally bequeathed in 1670 by Lady Jane Mico for redemption of white slaves held along the Barbary Coast in the Mediterranean (see Campbell, 1971).

legacy of such a system has had on the quality of individuals who are recruited in the profession today. I shall, therefore, attempt to summarise in a quite reflective way some of the themes, questions and issues that gather around this system.

While the school system remained small, there was no need to establish any kind of formal teacher training programme. As was the case in England, schools in the English-speaking Caribbean had a history of association with religious organisation and of selecting teachers based on this association (Gordon, 1963). However, by the end of the 19<sup>th</sup> century, because of the 1869 Keenan Report<sup>3</sup> in Trinidad and Tobago, the need for a greater supply of local teachers was felt and this need called for some preparation for recruits into teaching. Indeed, one of the recommendations of the Keenan Report was that a system of monitors be instituted for providing highly qualified teachers (see Gordon, 1963 for a more extensive discussion of the Keenan Report).

Following its successful implementation in Trinidad and Tobago (1870), the monitorial or pupil-teacher system was introduced in Jamaica in the early 1880s as a means of recruiting and training primary school teachers. In its established form, as applied in Jamaica, superior graduating students from primary school who were interested in teaching were recruited to the profession and in conjunction with their parents or guardian, entered a four-year engagement with the manager or head teacher of the school, free of charge from the date of the engagement. At least four hours of personal instruction from the head teacher or some qualified teacher on the staff was given during regular school hours each week. They then served as apprentices to suitable qualified teachers, assisting in teaching small groups and studying during after school hours. They were generally called 'monitors' during the first year and after passing the first examination they were called 'pupil teachers' (Gordon, 1963).

During their engagement, a pupil-teacher had to take an annual examination set by the Department of Education. This examination was written in subjects normally taught in the primary school, but at a progressively more advanced level, together with elementary

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<sup>3</sup> Patrick Keenan was asked by the British Government in 1869 to investigate the state of education in Trinidad and to make recommendation for its improvement. Keenan recommended the abolition of the normal school and the initiation of a system of paid monitorships. For a more extensive discussion of the Keenan Report see Gordon (1963) *A century of West Indian Education*.

educational theory. They were graded into three levels, denoted by years: Preliminary 1, 2, and 3. If these were successfully completed the pupil-teacher would be deemed qualified to enter a teacher training college. The pupil-teacher system was to survive side by side with intra mural teacher training programmes well into the twentieth century.

The heavy reliance of the educational system on the pupil teachers was reflected in the fact that in 1938 over 15% of the pupils who had completed the highest class in primary schools became pupil teachers (Miller, 1995) and, in 1943, pupil teachers constituted nearly one third of the teaching staff of primary schools (King, 1987). Furthermore, throughout the Caribbean, pupil teacher examinations were sat by many elementary school students who were not employed as pupil teachers, and had no intention of entering teaching (Miller, 1995). Hence, the pupil-teacher system serves not only as a means of teacher recruitment but also as the admission standard for the training and employment of other professions, including in the private sector. Indeed, during the colonial era and for some time thereafter, teacher training colleges were perceived as stepping stones to university or at least to a more prestigious occupation in the civil service or a bank.

One of the most challenging recent texts to offer fresh insights on the pupil-teacher system is *A History of Education in the British Leeward Islands, 1838-1945* by Howard Fergus (2003). This arresting and original book explores the social and economic forces that have shaped and constrained the development of education in the British Leeward Islands following emancipation. The book contains a richly developed argument about the impact of the British colonial education and highlights many of the ideological problems and practices entrenched in the education system of the Anglophone countries of the eastern Caribbean.

Writing about the pupil-teacher system, Fergus offers a polemical counter-narrative to explain why this system remained in some of the English-speaking Caribbean countries right down into the 1980s. According to Fergus, these teachers, also called 'apprenticed monitors' were unpaid thus they were seen by the establishment as a source of "very cheap labour" (p. 97). He writes:

The pupil-teacher system was ideal for maintaining a grossly under-financed program of elementary schooling, but stopped narrowly short of being exploitative child labour. Judged by its purposes it was highly successful and the teacher-apprentices

obtained in the process an element of secondary education that they would not have otherwise received. (p. 97)

Indeed, similar concerns were raised in England in the 1886 by HMI, the Rev T. W. Sharpe when he gave evidence before the Cross Commission<sup>4</sup>. Sharpe was concerned that many pupil teachers, particularly those in smaller voluntary schools, were exploited at the hands of unscrupulous head teachers. He suggested that if pupil teachers had the misfortune to be apprenticed to such head teachers they would receive very little instruction in the art of teaching and would merely serve as drudges for particular classes. Taking a similar line, the Rev Canon Warburton in his evidence before the Commission reported that many pupil teachers were the most overworked class of the teaching profession. It is no wonder then, that Fergus warns us of the potential abusive nature of the pupil-teacher system. There is one other point which may well be referred to here. What is interesting about Fergus' observations is that though he was writing about the Leeward Islands, he might well have been referring to any of the countries with a British colonial past, since this system was in place in all of them (see Gordon, 1963; Whyte, 1977).

### *1.2.5 Reform of teacher education*

In the 20<sup>th</sup> century education became a sensitive social, economic and political issue in most Caribbean countries. In Jamaica, it became increasingly clear to anti-establishment thinkers that education was of vital importance to the upward social mobility of the nation's masses. Such debates inspired the Jamaican people to collective public action and were widely viewed as part of the larger struggle over their subjection to imperialism. The mobilisation of the masses resulted in social unrest in the 1930s, culminating in the 1938 riots and spurred constitutional change in 1944. In that year, political power in Jamaica was democratised through the introduction of adult suffrage and representative government. Changes in teacher education after 1953 were consequences of the far-reaching constitutional, political, social and economic reforms following the 1930s social upheavals.

The radical departure of traditional pattern of teacher education in 1953 was driven by two major developments. First, policy and administration were transferred from the colonial

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<sup>4</sup> The Cross Commission on Elementary Education was set up by the government in 1886 to investigate the workings of elementary education. For a more extensive discussion on the recommendation put forward by the commission see Hadow (1926, p. 21).



officials to the people duly elected representatives. Consequently, some government departments were merged or converted into the creation of Ministries. The Department of Education and the Jamaica Schools Commission was abolished and replaced with the Ministry of Education. This constituted an important paradigm shift since a centralised Ministry of Education was responsible for educational policies, including the selection and training of teachers. Accordingly, an independent Board of Teacher Training was established, with authority to certify teachers in Jamaica. Furthermore, all powers related to the training of teachers were devolved to that board. Although the Department of Education previously had certified teachers without the benefit of a board, its creation was deemed necessary in ensuring that the Minister of Education, a politician, would have no direct say in the selection and training of teachers.

Another imperative development in the reform of teacher education was the establishment of the Department of Education by the University College of the West Indies in 1953. As part of its mandate, the new Department of Education agreed to train secondary school teachers through its Diploma in Education Programme. The Diploma in Education was implemented in 1954 and according to Miller (1995) was the first credential offered by the fledgling Caribbean university without endorsement from London University, its mentor. This development provided Jamaica with a substantial number of trained teachers and at the same time significantly reduced the levels of untrained teachers in the various school systems. Notably, by the middle of the 1980s Jamaica had reversed the colonial trend of large numbers of untrained teachers in the education system.

#### *1.2.6 The new deal for education*

The reform of teacher education in Jamaica took another turn in 1966, under the 'New Deal for Education in Independent Jamaica'. This was the second watershed reform of teacher education in Jamaica and was related to wider and far-reaching reforms in the entire education system. It introduced the new junior secondary schools, expanded comprehensive secondary education and engaged in massive capital expansion of the entire educational provisions. It was, according to King (1987) "a new philosophy" of education in Jamaica (p. 101). This new philosophy was the first comprehensive and systematic attempt by the government to provide the best education for every child regardless of socio-economic status (King, 1987; Mordecai & Mordecai, 2001; Thomas, 2013). It affirms that education would

result in a unified system open to all and would no longer serve as a divisive force in the society. Accordingly, the New Deal, as these reforms were labelled, set out a range of policies that were geared at ameliorating some of the socio-economic, racial and class inequities established during the colonial period, when elementary education was provided for the less privileged children and secondary and university education was the monopoly of the ruling class (King, 1987).

The New Deal was funded by the World Bank, the Canadian International Development Agency (CIDA) and the United States Agency for International Development (USAID) and was the first to benefit from multilateral and bilateral donor assistance (Thomas, 2014). Accordingly, as would be expected, the 1966 reform of teacher education was more wide-ranging than that of 1953. Its major tenets in summary included:

- The number of primary teachers to be trained would be expanded several-fold, with existing colleges extended and new colleges established. In fact, the training of all primary school teachers was articulated as one of the priorities of teacher education
- The number of scholarships to the University of the West Indies through its Institute of Education, Board of Teacher Training was to be further increased and in-service training for teachers was to be expanded and intensified.
- The introduction of training for secondary school teachers from Grades 7 to 9. Up to 1966, these colleges had only trained elementary school teachers.
- Additional teacher education training programmes were to be setup at the College of Arts, Science and Technology (CAST) and the Jamaica School of Agriculture (JAS). With the introduction of these programmes, the government recognised the need for trained teachers in agriculture and technical education.

Throughout these developments, the process of selecting and preparing teachers for the classroom showed definite signs of being influenced by the legacy left by the British colonisers (Thompson et al, 2011). For example, even though the Diploma in Education was granted by the University of the West Indies, the University of London continued to train graduate teachers for secondary education. To many Jamaicans the pervasive narrative was that English universities offered a better standard of education than those in the Anglophone Caribbean countries. Indeed, even today, it is not uncommon to hear many parents, past students and persons holding important policy and policy advisory positions in Jamaican

society express nostalgic views of their secondary school teachers in terms of graduates of prestigious English universities. While, in the same breath, Jamaican nationals educated in local and regional institutions are perceived in an unfavourable light compared to those past 'icons'.

An important question that must be answered in Jamaica and indeed the other Commonwealth Caribbean countries is, what impact have these reforms in teacher education had on improving teacher quality, and ultimately the quality of education in the school system? There is also a further set of questions, which concerns the extent to which these 'new' directions in teacher education are evolutionary or revolutionary. There seems to be little research into the effects of these reforms on the quality of teacher preparation. However, debates continue to be heated and opinions varied, but there is a general acceptance amongst political leaders and educational policy makers that the reforms have profoundly reshaped teacher education and in so doing have made teachers better prepared for the increasingly diverse classrooms in Jamaica.

#### *1.2.7 Reform of secondary education*

The major reform of secondary education in the populist era was the creation of the new secondary schools through a two-step process. First, was the conversion of 16 senior schools, established in the 1940s, into junior secondary schools and the building of 50 new schools. The establishment of 66 junior secondary schools constituted the largest single investment in education in the post-independence period. These were three-year schools, with non-selective, free flow, feeder school entry and a broad-based curriculum. Almost immediately after the creation of these three-year schools, they were converted into five-year institutions and renamed new secondary schools. Their enrolment by 1978 was approximately 80,000 students, which was more than all the other types of secondary schools combined.

A significant development in the early 1960s was the introduction of the comprehensive schools that sought to diversify secondary education by increasing its technical and vocational content. This type of secondary school was distinctive in combining both selective and feeder school entry strategies as well as widely diverse curricula and assessment procedures.

In 1979, the addition of grades 10 and 11 to the existing junior secondary schools, saw them being upgraded to new secondary schools. The new secondary school was substantially

different from the other types of secondary schools in that its entry was non-selective, its curriculum was oriented to vocational training, and its school graduates were not required to take Cambridge examinations. Consequently, certificates from these institutions (the locally administered Jamaica Secondary School Certificate) had low social currency, as neither the general public nor employers valued them (Miller, 1990). Since passes in the external examination were required for university admission, the new secondary schools did not constitute a route to higher education and their strong vocational bias meant that they were seen as catering largely to the working class. Accordingly, new secondary schools attracted the lowest social status of the five types of secondary schools although it offered the greatest access to secondary education. Put another way, the greatest access to secondary education was offered through a type of school that attracted persons of lower social status.

### *1.2.8 Recent developments in Jamaica's education system*

Jamaica has long recognised the value of education to economic development, and for many years has dedicated a sizeable proportion of its national budget to education. Over the last two decades, there has been a strong emphasis on expanding educational opportunity to all students. To this end, many changes have taken place to improve the efficiency and effectiveness of the education system.

The main changes are encapsulated in the following policies and plans:

- *The White Paper, Education: The Way Upward – A path for Jamaica's Education at the start of the new Millennium* (Ministry of Education, Youth and Culture, 2001).
- *The Task Force on Education Reform 2004 Jamaica Report*, and the resultant *Education Transformation Programme* (commissioned by the Ministry of Education, 2004).
- *Vision 2030 Jamaica National Development Plan* (Planning Institute of Jamaica, 2011).
- *The National Education Strategic Plan (NESP) 2011-2020*.

The government's 'White Paper', in recognising that schools must serve the needs of a diversified student body in an era of globalisation and technological changes, outlines the steps necessary to enact whole-system reform in the Jamaican education system. It encompasses both profound structural change and rigorous attention to standards. It also

outlines a direction for curricula and qualifications which is intended to allow stakeholders to learn from and outpace the other countries of the English-speaking Caribbean.

The 'White Paper' also sets out the following critical minimum targets:

- Five percent annual improvement in the number of students passing English and mathematics at the Caribbean Secondary Education Certificate examinations (CSEC), in relation to the total Grade 11 sitting.
- Upgrading of the curriculum teaching and learning support systems with focus on literacy and numeracy.
- Exposing school boards and principals to new governance with emphasis on leadership and administration.
- Building community participation and ownership of schools to influence positive behavioural changes, and stimulate a higher level of involvement.

More recently, confronted with the many challenges in the education system, the government commissioned its latest initiative, *Vision 2030 Jamaica National Development Plan*. As a first step towards transforming the education system, Vision 2030, through a consultative process, developed and articulated the following shared national goals:

- Ensure that every child has access to early childhood development.
- Improve the learning environment at the primary and secondary levels.
- Ensure that graduates from the secondary levels are ready to go on higher education, training or work.
- Promote and use standards to measure performance of the education system based on results.
- Ensure that adequate high-quality tertiary education is available.
- Ensure access to educational training opportunities for disadvantaged groups including unattached youths<sup>5</sup> and persons with disabilities.

However, despite recent gains in participation in the education system and clear government commitment to education reform, concerns have been voiced by educators and business leaders about the general standard of education, the lack of skills and the attitudes of recent

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<sup>5</sup> For this research, unattached youth will be defined as those who are in the age group of 14-24 years, unemployed or outside the labour force, and not in school or in training.

school leavers, and about the performance of Jamaican students in their examination results, particularly in the Secondary School Certificate examinations. Wayne Campbell (2013) describes the education system as “transient in nature, despite pockets of excellence scattered across the various layers of the system” (p. 6).

Dissatisfaction with poor educational outcomes has shifted the focus of attention to the teachers’ role in the classroom, with some politicians castigating them for their lack of commitment and unwillingness to teach mixed ability classes. In fact, at all levels, teachers are now being called to account for what they deliver to the nation’s children – often about problems of illiteracy, examination results and violence in schools. In the media, local newspapers maintain an often informed and influential dialogue about the state of schools and the status and role of teachers. For example, an editorial in *The Gleaner* held teachers to account for underachievement and ill-preparedness of school graduates for work (*The Gleaner*, 30 July 2014). This has fuelled many unfounded criticisms of teachers who are consistently blamed for the less than desirable performance on their students on annual standardised tests. On the surface, the damning report of the National Education Inspectorate (NEI) (2012), might seem to justify these claims. It identifies multiple concerns about poor academic performance, which include inadequate teacher qualification, low teaching quality and insufficient instructional materials. However, both anecdotal and empirical data have pointed to more deep-rooted problems of management and leadership within the Jamaican public education system (see Palmer et al, 2014). This has ignited an increasingly vociferous movement calling for further reform.

Jamaica is by no means new to educational reform. Over the past three decades, considerable efforts have been made to address the limitations in the education system in general, and in science achievement in particular. For instance, this period has seen the revisions to primary education through the Primary Education Support Project (PESP). This project was officially launched in January 2001 as a continuation of the gains made in the early nineties under the Primary Education Improvement Projects I and II (Evans, 2001). These efforts are also evident in the formal replacement of the Common Entrance Examination (CEE) in 1999 with the new Grade Six Achievement Test (GSAT) that is derived from the school curriculum up to that level. The GSAT is different from the CEE in the following ways:

- The GSAT is mandatory for all grade six students plus those students who would turn 12 years by the end of the school year. The CEE was not grade-related nor was there any requirement for 12-year olds to sit the examination.
- The GSAT includes English, Mathematics, Science, Social Studies and Writing while the CEE included English, Mathematics and Mental Ability.
- The GSAT selects students for Traditional High Schools, Comprehensive High Schools, Technical High Schools and Junior High Schools. The CEE selected students for Traditional High Schools and Comprehensive High Schools.
- The GSAT employs a Computerised School Selection and Placement System while in the case of the CEE a committee did the selection and placement.

The GSAT and the CEE are similar in the following respect:

- Both are used as instruments for selecting the students to be placed in secondary schools.
- Both use merit, students' choices and student residence as the criteria for selection and placement in secondary schools.
- In both cases the criteria listed above are used to place all the students selected for traditional high schools but only some of the students placed in Comprehensive High Schools.

An important objective of the GSAT is to place all students into appropriate secondary school programmes by abandoning the selection test process and relieve students of the anxiety often suffered as the examination date approaches. The GSAT also radically reformed the way children were taught science, increasing the amount of practical and maths-based work. In this sense, the GSAT must be viewed as a positive step in the right direction, since it fosters the teaching of the scientific skills that are emphasised in the curriculum and reduces the practice of teaching towards the test that previously took place with the CEE. Moreover, the replacement of the CEE as a placement tool has also eliminated the use of the examination results for assigning students to schools in a manner that maintains the inequitable hierarchical structure, by promoting an elite few at the expense of the self-worth of many. In recent times the GSAT results have come in for quite a bit of discussion in both the print and electronic media. This follows a study by the Ministry of Education (2004) which shows that

the test is not meeting adequately the demands of the nation's changing education sector.

The study unearthed the following findings:

- The current profile of GSAT is not best suited to the objectives of the Revised Primary Curriculum.
- Current practice promotes competition in placement but does not provide for real equity.
- Some students called the experience 'scary' and complained that the demands of the examination are too stressful.
- There are questions about whether it is appropriate for an end of grade six test to be given before all of the grade six curriculum is covered (test is sat in March of each year).

The above discussion raises an important question concerning the equity and fairness of the policy of selection and placement used for CEE and now GSAT. This question seems to be at the root of the dissatisfaction being expressed (see, for example, Antoine-Smith, 2014). It is therefore unfortunate that the introduction of GSAT has not resolved the inequitable difference between different types of secondary schools, particularly in the policies used to select their students. High-performing GSAT students are placed in schools noted for high academic achievement, while those with average to low performances are found throughout the rest, some of which are lacking in basic resources.

At the secondary school level, the major thrust of educational changes has come through the Government of Jamaica / World Bank Education Project, the Reform of Secondary Education (ROSE) programme. This reform was implemented in 1994 and was designed to improve students' performance in mathematics and science, to equip young people to successfully face the challenges of a changing world, and to prepare them to function as useful citizens and efficient workers. It emphasised skills of inquiry and provided a common integrated curriculum for Jamaican students in grades 7 to 9. Students satisfactorily completing their Junior High School Certificate Examination (JHSCE) at the end of grade 9 are eligible to proceed to a course of studies at the upper secondary level, leading to the Caribbean Secondary Education Certificate (CSEC) Examination at Basic Proficiency, General Proficiency or Technical Proficiency, depending on the subject and the proficiency at which it is available.



The ROSE curriculum promotes the development of 'learning skills' considered critical for the 21<sup>st</sup> century (Reform of Secondary Education, 1992):

- Problem solving
- Creative thinking
- Critical thinking
- Divergent thinking
- Decision thinking
- Cooperative and other kinds of group work
- The application of learning through real-world experiences.

The ROSE programme is perhaps the most important of the twentieth-century reforms of education in Jamaica and probably the most comprehensive in dealing with the weaknesses inherited from the colonial period (King, 1998). Indeed, the success of the programme in addressing a wide variety of educational quality issues such as coordinated curricula, teacher training and professional development, and the availability of suitable educational materials, has been recognised by many educators and scholars. It is therefore unfortunate that almost fifteen years after the programme was implemented into schools, there is still concern about the quality of education and students' performance.

One of the most intractable problems facing Jamaica and other Anglophone Caribbean countries is the problem of recruitment and retention of highly qualified teachers. Today, as in the past, the weak remuneration associated with the teaching profession continues to make it difficult to attract and retain people who are dedicated to the profession. School doors still revolve constantly with individuals who use teaching as a stop gap while they await opportunities to pursue more prestigious or lucrative careers. Moreover, the number of teachers lost from the profession due to overseas recruitment has significantly increased within the last decade. As a result of direct recruitment drives, conducted without the involvement of the Jamaican government, more than 500 teachers left the classrooms in 2010 alone to take up assignments in New York and London (Boffey, 2015; Clarke, 2002). This loss of approximately 3% of the Jamaican teacher workforce, many of them being the most qualified, created a considerable shock to the Jamaican education system, especially in mathematics and science.

### 1.3 School types in Jamaica

Between the ages of 10 and 12 years, most the Jamaican school population passes through a selection process which, for most children, determines the kind of secondary school will thereafter be attended. The selection process takes the form of a Grade Six Achievement Test (GSAT) consisting of tests in Language Arts, Mathematics, Communication Task, Science and Social Studies. The highest achievers in this examination are given an opportunity to attend a traditional high school which offers a five-year course leading to a General Secondary Education Certificate (CSEC). The traditional high schools are of the kind that would traditionally be regarded as 'grammar schools'. Since they are relatively few compared with the quantity of parents wanting to send their children to them, they experience a very keen competition for the places that they have available. Apart from the children coming into them through the Grade Six Achievement Test, these schools are also free to admit additional fee-paying students, so that many parents of middle and upper social status who can afford it pay to send their children to these schools irrespective of Grade Six Achievement Test results. Probably about 10% of the island's school population is educated in these schools.

The remaining children, comprising the vast majority of the secondary school population, depending at the moment on the locality in which they live and the type of school that is available, continue their education from this stage in one of three types of schools: junior high, technical high and upgraded high. As Evans (2001) noted those who did well were guaranteed a place in one of the select [traditional] high school, and those who did not were relegated to school deemed inferior. These schools, particularly the junior high which were historically the common schools built to educate the children of former ex-slaves (Evans, 2006).

Of the secondary schools mentioned above, it is perhaps reasonable to say that junior high schools have the lowest status. Unlike the other schools discussed in this study, junior high schools have limited educational opportunities. Indeed, while most secondary schools offer two cycles of education, the first cycle covers grade 7-9, and the second cycle grades 10 and 11, the junior high offers only the first of these cycles. Moreover, the World Bank (2001) report found that the students in the junior high schools scored much lower on average than the traditional high schools in mathematics and English language. They also highlighted weaknesses in reading as a further impediment on junior high school students' ability to

comprehend science (see p. 107 of the report). These realities affect the motivation of students and teachers. Evans (1991) found that one-third of a sample of junior high school students said they dislike their school.

In 2001 under the Reform of the Secondary Education the New Secondary schools (see Section 4.7) were upgraded and reclassified as secondary high schools, sometimes referred to as upgraded high schools. It is interesting to note that although the secondary schools now share a common nomenclature, many research studies indicate that the upgraded high schools remain substantively in a separate stream (see, for example, Clarke, 2011). Available results data from the Caribbean Secondary Education Certificate (CSEC) examinations, show that the upgraded high schools generally are the poor performers. For example, in 2013, 89% of the cohort in upgraded high schools failed English, compared to 37% in traditional high schools. For mathematics, 96% of the cohort in upgraded high schools failed mathematics, compared to 59% in traditional high schools. There are also much anecdotal evidence which suggest that the mass of students that transition to upgraded high schools through GSAT are numerate deficient and illiterate, with many attaining scores ranging from 0 to 20% in the core areas of English and mathematics. As a result, some parents expressed dissatisfaction in sending their children to these institutions, since they were not a part of the academic stream that encompassed a clear part to higher education and social mobility. Indeed, scholars such as Miller (1990) argued that these upgraded high schools reinforced the system of dual and unequal education in Jamaica.

The technical schools offer a mixture of academic and technical/vocational curriculum, although more emphasis is placed on the technical/vocational subjects. Historically, these schools are perceived as inferior to traditional high schools but with a higher status than the junior high schools. The World Bank report of 2004 shows that less than half of the students in the technical high schools participate in the Caribbean Secondary Certificate Examination, which is the key examination for admission in tertiary education and employment.

Private schools in Jamaica, in the main, are funded in whole or in part by charging their students tuition. Hence, they attract more socio-economically advantaged students. Research carried out by Lacoste (2012) shows that not only do private schools have a more advantaged student population when compared to the junior high, technical high and the upgrade high schools, but have more material resources and fewer teacher shortages. Furthermore, private

schools have smaller class sizes and are built around open communication between parents and administration (Evans, 1991). Private schools also have reputations for maintaining high standards for discipline and respect. Lower staff-to-student ratios allow for more effective observation and control of students in and out of lessons. This greatly improve the quality of the educational experience and achievement.

Nero (2009) argues that since the private schools in Jamaica cater for a primarily upper middle class and upper class student body, students come to these schools already proficient in JSE. They are thus at a greater advantage of accessing curriculum content than the Creole speakers in the junior high, technical high and the upgrade high schools.

Part of the aims of education in all type of secondary school, as pointed out already, is that each child should acquire a science qualification and of course the officially accepted language, English, irrespective of whether the child was originally Creole-speaking. It is obvious that the five types of school just mentioned have common problems with the language of science instructions although the problems in the technical, junior high and upgraded schools are likely to be more acute and serious kind for the following reasons:

- The population in these schools is composed almost entirely of children who were low achievers in the Grade Six Achievement Test.
- A higher proportion of creole-speaking children would be found in these schools than in the traditional and private schools.
- A higher proportion of children who come from poor socio-economic backgrounds would be found in these schools, and the problems associated with such backgrounds: low family literacy, low motivation for traditional literate interests, and so on, would be more acutely felt in these than in private or traditional high schools.
- The educational resources of the schools in the form of educationally qualified and trained teachers and the availability of educational materials would as a rule be lower than in the private or traditional high schools. In fact, the junior high schools are likely to be even worse than the upgraded schools in these respects, since the latter schools for the most part have been recently equipped and staffed on a scale which has never been usual for the traditional and generally primary-educated oriented junior high schools. In terms of educational resources therefore, there is a hierarchy with the

schools in the order junior high, upgraded and technical, private and traditional, beginning with the lowest and ending with the highest.

#### **1.4 The Jamaican linguistic situation**

Jamaica is one of the many countries in the world that has two languages, and a 'language problem'. The official language is Jamaican Standard English (JSE), the tongue spoken formerly by her colonial masters; all of Jamaica's official institutions use this language. According to Pollard (1998) it is not only the language that is used in official government communications, the courts, the banks and the established church but also the formal language of education in all learning institutions. In her socialist text, *English in Jamaica: The Coexistence of Standard Jamaican English and the English based JC* (2006), Antje Bernstein describes JSE as a derivative of British English, that has undergone extensive development with constant influences from other languages, such as a variety of West African languages, other European languages, Jamaican Creole (JC) and American English. Bernstein argues that it was this development that created the version of Standard English that is spoken in contemporary Jamaica. This view is also supported by socio-linguists, such as Cassidy (1971), who posit that British English in Jamaica was mainly influenced by the different British populations groups of colonisers: English, Scottish and Irish English. However, in modern times, the amalgamation of British English and American English has given JSE its own characteristics, although, in some respects, specific dialectal vocabulary can still be identified from its colonial inception.

JC is Jamaica's unofficial language, which has been inherited by modern Jamaicans from their slave ancestors. The languages, however, do not enjoy equal status within the society and remain broadly incompatible and non-synchronous. The socio-linguistic reality is that JC is historically associated with the African-Jamaican majority and considered the voice of the poor and marginalised communities while JSE, the official language of the state, is associated with the educated, of high status and concomitant with the minority of inter-racial and European-Jamaican members of the society.

##### *1.4.1 English as agent of civilisation*

Since the colonial period, the English language has held a very powerful and influential place in Jamaica. The British coloniser's objective was clearly expressed in a well-known circular

despatch as a position accepted by governments within the Anglophone territories. The aim was to use the language of the empire as a kind of cement to bind peoples to one common aim and destiny, namely the continuance of the empire:

To diffuse a grammatical knowledge of the English language, as the most important agent of civilisation, for the coloured population of the colonies. (Circular despatch 1847, cited in Augier & Gordon, 1962, p. 182)

Within this objective, the English language was not considered merely as a means of communication but as something invested with the ability to re-form subjects into replicas of English men and women of a particular class. Indeed, English was seen as the native tongue of Jamaica and privileged even in its spoken form. For instance, the Inspectors of Schools Report constantly referred to the inability of the children to express themselves properly in their 'native' language and advised teachers to pay special attention to the spoken language of the scholar, with regular drills on errors of grammar in everyday speech and surveillance, which should extend even to the playground (Education Department, 1915).

#### *1.4.2 Attitudes to language in Jamaica*

Reports that come down to us from as recently as 25 years ago and my own experiences of having been born and brought up in Jamaica, indicate that language attitudes are very unambiguous and simple (Cooper, 1995). Creole speech was generally stigmatized: it was referred to as 'bad English' or 'broken English' (Craig, 1976a, 1976b). However, JC stands roughly in relation to JSE as English once stood in relation to Latin, although it is no more correct today to call it a corrupt English than it would be to call English a corrupt Latin.

More generally, JC was regarded as the sign of a lack of education or of poor education, and consequently of low social class. The behaviour of JC speakers showed that they themselves regarded their language and themselves in these ways. In the presence of strangers, or in prestigious social situations, they tried as much as they can to speak like JSE speakers and became embarrassed at failure in this respect. When asked, they never admitted to being speakers of JC, but insisted that JSE was the language they spoke. These behavioural patterns of Creole speakers at that time can be understood in terms of the hegemony of the English language (hegemony is discussed in Section 2.12) and the aspirations towards a

social mobility that could be achieved through English, as a result of the judgements of status that were usually based on English speech.

Similar attitudes were noted in the Inspectors of Schools Report of 1916 and 1917. The reports give no sense of the inspectors encountering anything that could be called a language. In this assault, the inspectors were sometimes disappointed by the language behaviour of those who should have been at the front-line of the attack, the teachers themselves. They brought to the classroom the language, JC, which they shared with the children. To the chagrin of the inspectors, it sometimes escaped from them, as it did from the children they taught:

Even the teachers in some cases resort to common or incorrect forms when teaching and questioning their classes. (Education Department, 1917, p. 68)

In visiting schools I have felt vexed to hear a teacher who ought to know better speak to the children in lower Standards in the same broken English they are familiar with in their homes. (Education Department, 1916, p. 343)

Another perspective on JC that does not always gets emphasised, is one that is seen by its speakers as rich, and a treasury of folk literature, songs and expressions. Indeed, from my own experience of living and working in Jamaica, it would seem reasonable to say that most Jamaicans are attracted to films, or radio programs delivered in JC. They love their proverbs and folklores in JC; it is also not uncommon to hear Jamaicans express the view that JC jokes are just not as humorous when put into JSE. Moreover, the richness of JC as a medium of artistic expression is also demonstrated in the works of international poets and reggae singers such as Louise Bennett, Bob Marley and Mutabaruka. For example, in the poem “Dry Foot Bowy”<sup>1</sup> Louise Bennett employs an earthy metaphorical proverb to satirize a Jamaican of peasant stock who has travelled to England and returned with an English accent and a bad case of linguistic amnesia. He can no longer converse with his former acquaintances, much to their annoyance, for he disclaims knowledge of JC:

Me gi a joke, de gal dem laugh  
But hear de bwoy, “Haw-haw!  
I’m sure you got that ballydash  
Out of the cinema!”

Same time me las me tempa, an

me halla, “Bwoy kir out!

No chat to me wid no hot pittata

I don’t think that I really

Understand you actually.

(Bennett, 1980, p. 206)

Nevertheless, aggressively snobbish towards JC in public, most educated Jamaicans feel impelled to denounce the language, declare that it is vulgar, ugly, crude, that it hurts their ears, and even, in some cases, maintain that they hate it or ‘never speak it’. The collective disdain for JC undoubtedly reaches its absolute pitch when the educated Jamaican travels abroad, even for a few months, and – as so often happens – returns to Jamaica, insisting to all who will listen that s/he has forgotten how to speak Creole. So, great is the official respect for JSE, and the contempt for JC, that in educated homes of the middle class and bourgeoisie elites, children after three or four years are scolded, and even beaten, for speaking JC, even though their elders use it constantly, and are disciplined into talking JSE.

In popular and academic debates in Jamaica, and in the minds of some Creole as well as JSE speakers, the conditions just outlined persist today. Nevertheless, it seems true to say that that in the most recent times, attitudes and practices in the formal, public spaces of the media, churches and public-functions towards the use of JC have been changing. The change, not surprisingly, intensified with the acceptance of JC as a language with its own grammatical integrity by international linguists and educators from the 1960s. This legitimization of Creoles in general, and JC in particular, confronted centuries of prejudice and challenged the hegemony of JSE from within. Another phenomenon that has contributed to the changing attitudes of most Jamaicans towards Creole is its accepted use by educated figures in official public-formal function. Consequently, it is not uncommon to hear popular talk show hosts using and encouraging the use of JC to increase the perception of their affinity with their audience.

In the Jamaican context, the dominance of English is played out in the everyday interactions of science classrooms where many teachers, consciously or unconsciously, fail to recognise the importance of the mother tongue of children and encourage children to express scientific



understanding, both oral and written, in English. In such cases, a student's accurate, insightful contribution to classroom discourse may be devalued when she or he uses the local language in the development of scientific ideas. Hazel Simmons-McDonald (1996) reviewed a range of studies showing that even at a young age Creole-speaking children bring a rich bilingual experience of scientific knowledge to class and, when given the opportunity, are able to make creative use of these experiences in moving towards scientific understanding. For example, in a discussion on the changes of the states of water, the children clearly had ideas about the scientific processes involved and could express their conceptual understanding in Creole. Yet these experiences often are not acknowledged in the classroom and science teachers continue to perpetuate a monolingual order of discourse.

Based on the foregoing discussion, if one accepts the notion of the importance to learning of the relationship between science education and language, then the case of Jamaica, where the language of instruction is JSE and many of the students are first language speakers of JC (JC), creates special problems. As such, there has been a recurring call from different interest groups for JC to be formalised in the education system, to serve as the medium of instruction in science classrooms, and to develop the language with a vocabulary wide enough to fill its new range of functions. Such advocacy is particularly relevant in light of findings from recent studies confirming that such a model significantly improves science understanding and is an integral tool for addressing inequalities in classrooms (Babaci-Wilhite, 2013). However, there has been a strong reaction to these calls by the educated elite and the media in Jamaica, expressing the following concerns: that such proposals will lead to regression in national development and will eventually result in cultural and economic isolation; that JC is not qualified to have a place in education because it is not a 'real language'; and that such an approach will keep Jamaican students behind their counterparts elsewhere (Bryan, 2010; Christie, 2003; Sebba, 2014).

These perspectives have come to dominate the language discourse debate but, unfortunately, the core arguments are made on economic grounds rather than discussing the harm of educating students in JSE, a language that most do not speak and almost never hear at home. For example, in *The Sunday Gleaner* column 'Corruption of languages is no cultural heritage' published on October 29, 1989, Morris Cargill contemptuously made the case for banning JC. Cargill argued that the Jamaican people's rhetoric had been degraded to JC and

wondered whether complacency at the decadent state that JSE was in would lead to a regression in national development. Cargill overlooks the research of many Jamaican linguistic scholars who have given evidence on the intricate link that exists between language, education and identity in the education system (see Bryan, 2010; Craig, 1971, 1976, 1980, 2006; Pollard, 2002). Moreover, such arguments should be understood in terms of the hegemony of the English language that has permeated every sector of the wider Jamaican community, including the education system. Undoubtedly, this situation has created a conundrum for educators and linguists, who continue to grapple with the question of how best to educate JC speakers; despite the growing body of research and accompanying literature on the foregoing observations and their impact on education in the Caribbean region and elsewhere, there remains a relative dearth of work related to the impact of language proficiency as a barrier to the teaching and learning processes of school science in Jamaica.

#### *1.4.3 Bilingualism in Jamaica*

In 2007, the Jamaican Language Unit (JLU) conducted a wide-ranging language competence survey to assess the ability of Jamaicans to 'code switch' between JC and JSE. The results seem to confirm the bilingualism that currently exist in Jamaica. Forty six percent of respondents were able to switch between both languages, and consequently demonstrated bilingualism. The findings showed, however, that a relatively higher percentage were monolingual, with a greater proportion being JC speakers. Remarkably, in an earlier 2005 survey, also conducted by the JLU, that examined language attitudes in Jamaica, it was reported that 78% of respondents declared themselves speakers of both JSE and JC. Although the two surveys assessed different levels of proficiency the results seem to confirm Jetta's (2010) assertion that it is a mistake to classify the Jamaican language situation in terms of classical linguistic concepts like bilingualism or diglossia.

The 2007 survey discussed above also examined bilingualism in terms of the demographic characteristics of the participants. The findings revealed two important relationships. Firstly, bilingualism was higher in the urban areas when compared with the rural areas. Among monolingual speakers, urban areas also have more monolingual JSE speakers than do rural areas. Secondly, there was a greater tendency for higher skilled or professional respondents to demonstrate bilingualism than respondents who indicated that they were unskilled or

unemployed. In addition, and unsurprisingly, JSE-speaking monolinguals tended to be concentrated in highly skilled and professional groups.

#### 1.4.4 *Diglossia or a continuum?*

Terms such as ‘diglossia’ and ‘continuum’ have been part of the vocabulary of sociolinguists for many decades. Indeed, since the groundbreaking article *Diglossia* by Charles Ferguson (1959), ‘diglossia’ has been used to describe the special and relatively stable coexistence between primary languages in bilingual communities. However, its use in some Anglophone Caribbean Creole communities, including Jamaica, has been questioned since Cassidy (1971) rejected it as a possible model for Jamaica, preferring a continuum model instead. The continuum model has proved to be a powerful and popular theoretical construct for dealing with variation between JSE and JC, albeit the arguments surrounding ‘decreolisation’<sup>6</sup> have proven highly controversial (Jetta, 2010). This section explores some of these arguments.

The term ‘diglossia’, as articulated by Ferguson (1959), describes a particular form of bilingual community where “two or more varieties of the same language are specialized by function and are used by some speakers under different conditions” (Snow, 2000 p. 165). Ferguson argues that the stable coexistence of the varieties in these speech communities means that a strict separation exist between them. Thus, the variants are not continuous but relatively distinct. In some respect, Ferguson’s model views and treats diglossia as a diachronically stable variant of bilingualism in the sense that one of the varieties has a higher prestige than the other (these he labelled as high and low ‘codes’). The ‘high’ form or superposed variety of the language is used for formal and learned domains while the ‘low’ or less prestigious form, which is not normally in written form, is used in more popular and less intimate situations.

Ferguson’s argument was expanded by Fishman (1967) to include the use of unrelated languages that occupy the ‘high’ and ‘low’ codes, such that one language is used in prestigious domains, while another language is used more informally, but primarily spoken. According to Fishman (1967), diglossia is not characterized by the use of two languages only. Thus, his

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<sup>6</sup> Decreolisation refers to the gradual modification of a Creole in the direction of the lexifier (Siegel, 2008). This articulation has been highly contested as sociolinguists such as Bryan 2010, Craig, 1999 and Siegel, 2008 argue that Creoles develop in an opposing manner; a process of basilectation away from the lexifier (recreolisation).

articulation of diglossia referred to all kinds of language varieties which show functional distribution in a speech community.

At some level, one may argue that there is some correlation between the models articulated by Ferguson and Fishman, and thus in this sense the linguistics situation that exist in Jamaica is indeed a diglossic one. The two languages, JSE and JC, do not enjoy equal status within the society. As I have previously argued, JC is normally associated with the African- Jamaican majority and considered a low status language while Jamaican Standard English, the official language of the state, is associated with the educated, is high status and associated with the minority of inter-racial and European-Jamaican members of the society. Thus, JC and JSE have highly specialized functions in the context of Jamaica. Furthermore, in line with Ferguson's revised 1991 paradigm of diglossia, both JC and JSE share most of the lexicon, albeit JSE is much broader.

However, to hold such a view is to ignore certain fundamental facts about the Jamaican linguistic map. Many contemporary Jamaican linguists have sided with the view that the Jamaican linguistic situation is discussed best in terms of a linguist continuum stretching from JC on the one hand to JSE on the other. Between these two extremes are three different segments:

- (1) the *basilect*, which describes the purest Creole and is spoken by the most uneducated Jamaicans in remote country villages. This variety is furthest from the standard and is therefore associated with those people with the lowest socioeconomic status and few opportunities for social mobility.
- (2) the *acrolect*, represented by those varieties closest to the standard form of the Creole's lexifier and spoken by the highly educated. Speakers of the acrolect have the best economic and cultural opportunities in Jamaica.
- (3) the *mesolect*, represented by the intermediate and wide-ranging varieties stretching between the two above-mentioned extremes. Patrick (1999) claims that in social and demographic terms, mesolectal speech is the most important variety in Jamaica since its broad limits include the speech of most Jamaicans.

Craig (1976) refers to such a formulation as a 'Creole continuum' or 'Post-Creole continuum'. According to Harry (2006), most speakers can shift their speech from one point to another on this continuum, without necessarily being able to take in the whole range.

An example of this continuum can be observed in the following Creole expressions, all of which means, *I am eating*: Mi a nyam (basilect); Mi eatin (mesolect); and I'm eating (acrolect). Each of these expressions convey the same idea: I am eating (JSE). However, there is a great variety in how one can convey the idea. What is interesting here is that Creole speakers will often use sentences from different ends of the continuum, often in the process of a single discourse, according to the varied social factors and personal interrelationships that impinge upon the discourse.

Craig (1971) observed that this continuum is created and maintained on the one hand by JC speakers striving to speak JSE and falling short in the attempt and on the other hand by JSE speakers doing the same in respect of JC. Craig (1971) highlighted the educational significance of the continuum concept. He pointed out that the West Indian is in a unique language situation in which "English is neither a native language nor a foreign language" (p. 2) and that in syntactic terms one could differentiate between the following levels of the Creole speaker's Standard English competence:

- (a) Standard English patterns that are actively known
- (b) Standard English patterns used only under stress
- (c) Standard English patterns passively known
- (d) Standard English patterns not known.

This is an important point for discussion since, from the perspective of teaching and learning, the complexities of the Jamaican linguistic map create both theoretical and pedagogical challenges for science instructions. As I have argued in Chapter 1, the 'science register' (the occupational variety of Standard English used by scientists) is distinct from the social language that students used in their everyday discourse.

#### *1.4.5 Language and social class*

In the Caribbean, particularly in Jamaica, linguists have long established interesting parallels between the notion of the 'Creole continuum' and social stratification (Anderson, 2014; Pollard, 1998; Sebba, 2014). The acrolect is the language of those who govern and come from a privileged background and has become an indicator of social class. In other words, speaking in the acrolect is a mark of social class, achievement and potential. It is, according to Pollard, "the linguistic badge which one wears when one wants to identify with a certain level of

sophistication, of linguistic competence, and of having “arrived” in a highly-stratified society” (Pollard, 1998, p. 9). A contemporary formulation of Pollard’s position is articulated by Melva Davids (2013). Here, she writes, “Jamaican Standard English, an emblem of cultural imperialism linked to our colonial heritage, is embraced as the language of prestige and social mobility” (Davids, 2013, p. 1). Conversely, basilect speakers have been tied to low socioeconomic status and poor education. (Bryan, 2010; Devonish & Carpenter 2007; Robertson 1996).

### **1.5 Language difficulties and science education in Jamaica**

The philosophy and practice of science education in Jamaica exemplify two implicit assumptions: first, that science learners are members of the same social community and are accustomed to the same value systems as those in which the curriculum of science education was prepared; and second, that teachers and learners are proficient at JSE, the language of instructions used in the science classrooms. These assumptions, I would argue, are incorrect and their falsity accounts for many of the problems in the learning and teaching of science in Jamaican schools, albeit no precise data are available. Such a situation raises questions about the consequences of using JSE in teaching and learning science, and also the effectiveness with which JSE has been taught to science teachers as part of their professional training.

No research has been conducted in Jamaica on the types of language difficulties encountered by science learners in Jamaica. However, at the level of anecdote and drawing from my experiences as a science teacher in an upgraded high school, the following problems are fairly well-known. First, there is the issue of mutual comprehension between the teacher and the learner. Many of my students were monolingual JC speakers and, as a consequence, they struggled to understand instructions that were given in JSE. The problems the students were having were not only of non-comprehension of JSE idioms, use of metaphors and of expression unacceptable within the morphological, phonological, semantical and syntactical framework of JSE, but of their inability to handle certain language forms that occurred over and over again in the description of experiments – the passive form, in particular. For example, it is more common for the Creole-speaking child to say *Mi do di experiment at room temperature. Mi see di sample fizz* (active voice) rather than *The experiment was performed at room temperature. The sample was observed to fizz* (passive voice). The passive form is

very infrequently used in Creole contexts and its manipulation is therefore difficult for Creole-only speakers.

There is a further, related problem of language differences between science teachers and learners. It is also the case in Jamaica that, in some instances, the teacher, as well as the learners, may have inadequate command of JSE. While some teachers are fluent in JSE when reading or writing, they are unable to speak it fluently when expressing the language of science. This, to my mind, creates special problems of comprehension in science learning, especially in advanced science where specialised vocabulary requires more detailed explanation.

Secondly, there is much evidence to support the claim that any language can be developed to express all the communication needed by the people who use it. However, with respect to JC, such a statement is one of possibility, not reality. JC has yet to develop words, expressions, and modes of meaning for communicating all of school science. This presents a constant and ever-increasing problem to Creole-speaking children when learning science through the JSE medium when they encounter a word that is not exactly equivalent or expresses no idea or notion formulated in JC. For example, words such as *classification*, *photosynthesis* and *hypothesis* have yet to be developed in JC and therefore the learner “cannot appeal to translation into his mother tongue for resolution of doubt or dissipation of ignorance” (Stevens, 1976, p. 58). Such situations are exacerbated through concepts, relationships, operations or processes which cannot be illustrated or displayed, e.g. *infinity* and *gravity*. Faced with such a situation, the Creole-speaking child will follow the teacher only so far as their language practices remain in common; they will seek to interpret what is alien to their thinking in terms of their own language and will either disregard in entirety what does not fit their own usage or misinterpret what appears to resemble their own practices.

Thirdly, a similar challenge for the teaching and learning of science in Jamaica is the notion of two meanings to one word: JSE meaning and JC meaning. For example, terms that have specific meanings in science discursive practice and are clearly part of the lexicon, such as *clot* and *salt*, have different meanings in JSE and JC. In JC *clot* means to ‘hit or strike’, but in JSE it refers to a thick mass of coagulated liquid stuck together. Similarly, the word *salt* in JC denotes ‘empty-handed’ or ‘low funds’ while used in the lexicon and discourse of science it refers to an ionic compound that results from the neutralisation reaction of an acid and base. A further

example is *belly* which in JC can refer to pregnancy. In such a situation, the JC speakers has to internalise two or three meanings of a given concept or word, none of which is the same as any JC meaning. In the kind of argument I have been developing, it is tempting for teachers to dismiss the learner's preconceived notions and ingrained non-scientific beliefs.

A further entrenched impediment to understanding and communicating science meanings in a Creole-speaking environment in JSE relates to sentences and phrase structures – syntax, the rules for constructing and comprehending sentences. According to Craig (1971), the syntax of JC is not that of JSE and the grammatical categories and practices of one cannot be transferred directly to the other. For Craig, both are complete systems of expression, according to their respective cultural and environmental needs. For the science teacher, problems arise because the discourse of the Creole-speaking child does not contain the same type of logic-structure which JSE contains. JSE favours complex sentences patterns and the use of abstract nouns, while JC uses fewer verb conjugations and favours a sequence of simple sentences with the most limited and fragile of linking words. The result is that the Creole-speaking child has difficulties in developing patterns of relationships among the meaning of key science terms and hence struggles to write about science ideas or experiments in JSE.

As an illustration let us consider the following two examples:

**Example 1**

JC

*Di wata dutty so all de fish dem dead.*

SJE

*The water was dirty so all the fish died.*

**Example 2**

JC

*To much suga no good fi you*

SJE

*Consuming too much sugar is not good for you.*



In both examples, it is clear that the Creole-speaking child is talking and thinking in ways that demonstrate scientific understanding. However, such expressions are frowned on in the science classroom and students who use them will have their paper heavily corrected. Such practices ignore the importance of JC as a valuable resource to science learning. Students' more nuanced understanding of their home language allows them to express more precise meanings when doing science. Thus, teachers can build on that knowledge by connecting it to the practice of science and provide opportunities for students to learn to use language, to think and to act as members of a science learning community.

### **1.6 My interest in the research**

My interest in this research was borne out of the preceding discussion and my own linguistic and cultural identity as a bilingual speaker of JSE and JC, along with my experience both as a student and science teacher in Jamaican secondary schools. I grew up in relatively poor circumstances in rural Jamaica during the 1970s and '80s. At that time, whether a speaker naturally acquired JC alone or the more-extensively accepted JSE alone, or both forms of language, was largely dependent on the pattern of social stratification in the community and the position of the particular speaker within that pattern (Craig, 1980). Accordingly, as a general rule, the lower the socio-economic status of the individual the more likely he or she is to be a monolingual JC speaker; conversely, the higher the socio-economic status, the more likely is it that the individual will acquire JSE. Within, this general rule, whether there will be individuals who naturally acquire both JC and JSE will depend on factors such as the nature and extent of interaction between social classes and motivations that are generated within the community to use each form of the language in different functional roles. The above observations are consistent with those outlined by Dennis Craig's (1976) assessment of the sociology of language in Jamaica.

Thus, having been brought up in what I have earlier described as poor circumstances, in my early years I grew up mainly as a monolingual JC speaker and, like many Jamaicans, acquired JSE when I made contact with the formal education system. Throughout my primary and secondary school education, I encountered great difficulties learning JSE and performing well in different written examinations, which required JSE. For me, the main problems related to the morphology, phonology and syntax of JSE. This problem was not unique to me since Craig points to sentences and phrase structures – syntax, the rules for constructing and

comprehending sentences – as a major impediment in understanding and communicating meanings in JSE in a Creole-speaking environment. Craig argues that the discourse of the Creole-speaking child does not contain the same type of logic structure which Standard English contains. Standard English favours complex sentence patterns and the use of abstract nouns, while JC uses fewer verb conjugations and favours a sequence of simple sentences with the most limited and fragile of linking words. The result is that the Creole-speaking child has difficulties in developing patterns of relationships among the meaning of key terms and hence struggles to write about ideas in Jamaican Standard English.

My parents were also Creole-speaking, except in formal circumstances, where it was desirable to attempt<sup>7</sup> to speak JSE. This, it was felt, lent dignity and prestige to the occasion. However, in social situations they relished using JC. It was in JC that they repeated the many Jamaican proverbs, slangs, the funny expressions of the era and political jokes that course through society. Yet, interestingly, they insisted that their children speak JSE in both social and formal situations. This is consistent with Craig's (1976) assertion that in Jamaica an unwritten rule is established that while the parents may speak to their children in JC, the children must reply in JSE, both as a token of 'respect' and so as to 'practice'. For my parents, the acquisition of JSE was seen as the most apparent passport to social mobility or symbolic of what Nettleford (1970) described as 'smadification'. Thus, from an early age I was systematically cultured in a duality of attitude towards language.

During the early 1980s, I was offered a scholarship to attend one of the more prestigious grammar schools in Jamaica. This school, in keeping with the grammar school traditions, offered an academically-oriented curriculum that was geared for more able pupils. Thus, they employed teachers who were, on average, better qualified and gave the principal a large measure of autonomy. The school also attracted a large number of students of higher socio-economic status and, consequently, proficient in their use of Jamaican Standard English. Although by then I had achieved some bilingual competence, I was far from being proficient in JSE. Thus, a conversation with my peers that began spontaneously in JSE might change,

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<sup>7</sup> My use of 'attempt' here suggests that in these situations there is a strong creolization of the JSE spoken. Errors are common, especially in grammar and syntax.

equally spontaneously, to JC. Occurrence of this type has been reported by sociolinguistics researchers. (see, for example, Bryan, 2010; Craig, 1978).

The school operated a restrictive language policy that emphasised JSE as the medium of instructions in classroom teaching and learning. Such a policy reflects an ideology of language that constructs or portrays languages other than JSE (and speakers of those languages) as deficient or problematic (Arias & Faltis, 2012). As importantly, it ignores the rich linguistic resources that bilingual students like myself bring to the classroom. Instead, in my school, much focus was placed on grammatical correctness and acceptable pronunciation rather than on meaning making.

Thus, it came as no surprise when, after the first term of my first year at the school, we were asked to write a language aptitude test. It was explained to us that this test was necessary because of the many different home and sub-cultural backgrounds from which the students came. Because the egalitarian aim of the society was increasingly bringing widely different children together into the same classroom, we were told that obtaining adequate information on language aptitudes would help the teachers to plan more effectively. On the surface, this seemed a reasonable argument if it meant that the efficiency of language-teaching could be improved. However, I can recall being rather suspicious of the school's motivations since, as a result of the test, students were streamed for language-teaching purposes, according to language aptitude. Such streaming created distinct groups of students with particular social identities. Thus, children from upper social-class backgrounds were predominantly found in the higher streams while those students of lower social status were mainly found in the lower streams. It would seem reasonable to conclude from these observations that social class is a strong determinant insofar as the quality of education is concerned.

During the 1990s' debates surrounding language and education, attention shifted from language as a theory to language as practice. Researchers such as Devonish (1997) and Shields-Brodber (1992) made the argument that the language that people communicate in everyday life is the most effective means of communication for creativity, initiative and productivity. Thus, they argued that JC must be adopted as the official language and actively promoted, and taught both in and out of the classroom. A contemporary formulation of Devonish's and Shields-Brodber's position is that of Carolyn Cooper, University of the West Indies professor in the Department of Literature and JC advocate. In a 1994 column in the

Observer newspaper, Cooper argued for a Creole-medium education. She proposed that students should be first taught to read and write in JC and then learn JSE as a second language, systematically, in language laboratories. Cooper suggested that the Cassidy phonemic system be transformed from a linguist's writing system into a set of practical writing conventions, and that new JC vocabulary be systematically developed to meet the needs of an official language. These ideas resonated with me as a young science teacher.

As a science teacher, many of my science lessons began by presenting students with science vocabulary and asking them to write the words, which would be followed by a discussion of the meaning of those words. In this model of instruction, I came to realise that the language I was using and the language of instructions in the textbooks were significantly different from the language the students were using to respond to my questions. Like many of my colleagues, I tended to concentrate on contextual matters without any consideration that the language of instructions I was using might be excluding some of the students I was teaching. It was during this time that I became involved in writing a science curriculum for one of the schools where I worked. I found that there was a shortage of information and advice for writers about bilingual and bicultural students and thus the ideas for this research began to form in my mind.

Furthermore, as part of my Master's degree at the (then) Institute of Education, University of London, I encountered Halliday's (1978) thoughts on language as a social semiosis and Kress and van Leeuwen's (2006) grammar of visual design in the production of meaning. These three authors influenced my ideas in different and fundamental ways and led me to recognise that the language of science instructions is not transparent and universally understood but culturally specific. Thus, I began to speculate on the problems faced by JC-speaking students. These ideas began to take further shape on reading the works of prominent Caribbean authors such as Alleyne (1996) and Craig (1971). Alleyne points to the fact that the Creole-speaking child needs to first encounter and experience science in their own language before having learning imposed upon them via codified discourse that is in the established language of science and scientists.

It is, then, for these reasons that this study considers the extent to which Jamaican students can access the language demands of science instructions. My approach will consider not only the readability elements of science instructions but take into account what Halliday (1978)

describes as the 'context of culture' and the 'context of situation'. The context of culture includes assumptions on the part of the author about the cultural experience of the reader. The context of situation involves the relationship between author and reader implied by the text and the relevant features of the situation and circumstances of the reading. Both have important implications for science instructions accessibility. Accessibility in the context of this research refers to the capability of readers to make meaning of a text regarding situations. Thus, accessibility is a broader and much more useful concept than text readability because it considers characteristics beyond simple text base (Gunning, 2003). Gunning (2003) argues that it is naïve to try to categorise texts without considering the context of the reader and the task at hand.

In the Jamaican context, the science classroom is a rich linguistic environment where students make use of a range of written and spoken texts which interact with one another. Accounting for social and cultural diversity in terms of the language of science and the language of instructions takes place at the classroom level. School science textbooks are amongst the resources which make this possible. Thus, given their importance and the continuing predominance of their use, science textbooks are given special attention in this research.

### **1.7 Science textbooks**

The outcome of much quantitative and qualitative research has highlighted the role of high quality science textbooks in realising the aims of national curricula and supporting effective teaching (McCallum & Miller, 2013; Oates, 2014; Walton, 2006). Unfortunately, both developed and developing countries alike have fallen behind in producing well-theorised, well-designed and carefully implemented textbooks (Oates, 2014). In my view, this has had a negative impact on the teaching and learning process and is an area that requires in-depth research and analysis.

In the Jamaican context, textbooks constitute an essential part of learning science. Textbooks are heavily relied on because of the scarcity of suitably qualified science teachers and the lack of scientific laboratory resources. Hence, it is imperative that selected textbooks meet the needs of the students; that is, they must provide the detailed knowledge implicit in the curriculum and give a broad description of the content that needs to be taught. Moreover, they should be engaging and comprehensible by students, with or without their teachers' supervision. Yet, researchers in many countries have reported that the science textbooks

recommended by examining bodies are fraught with problems (Khine, 2013; Leonard & Penick, 2013; McCarthy, 2005; Yong, 2010; Taber, 2015). Although many studies have examined the readability of textbooks, there is a significant lacuna in the literature in relation to other factors which affect the accessibility of science textbooks. Thus, this research will add to the limited literature on the extent to which recommended science textbooks are accessible to Jamaican students.

The role of science textbooks in the classroom has long been the focus of many international studies (Otero et al, 2014; Qualter, 2014). Researchers such as Digisi and Willet (1995) argue that high school teachers in the USA frequently use science textbooks to achieve the following: preview areas to be covered in a lesson; reinforce the lesson; and have students learn information independently. Likewise, Tim Oates (2014) observes that science textbooks encourage clarity regarding key concepts and core knowledge, provide clear learning progressions and support learners' reflections. In most Jamaican schools, they are used as teaching resources to provide information to prepare or reinforce lessons and are also used by pupils to help them complete homework assignments. Research in Jamaica has consistently revealed that students at primary and secondary levels experience difficulty in reading science textbooks (Clarke, 1984; Douglas-Smith, 1995; Lodge, 2002; Shillingford, 1990; Thorpe, 1994). According to Soyibo and Briscoe (1998), some prescribed textbooks are seldom used because of their inappropriateness to both teachers and students. Their study revealed that only 12 of 160 students were able to read comfortably a recommended textbook when the Cloze text procedure was used. Clarke (1984) argued that the major difficulties experienced by students in handling the vocabulary features and graphic format of science textbooks recommended for grade 7 students might be linked to textbook difficulty and lack of adequate reading skills enabling students to deal efficiently with features of the organisation of the textbooks. In another interesting study, Soyibo (1996) made a comparison of three high school biology textbooks used in Jamaica and found that the texts were difficult for the target students to read and understand. The findings of these studies have important implications for science teaching in Jamaica and in the wider Caribbean context.

Other research has pointed to additional shortcomings with science textbooks (Bryce, 2011; Hammad, 2014; Sleeter & Grant, 2011). These include each text's layout, concept difficulty and density, writing style, specific content (e.g. formulae and graphs) and lengths of

sentences (Benjamin, 2012; Bryce, 2011; Mason et al, 2013; Soyibo & Thorpe, 1995). Reading, technical and non-technical vocabularies, linguistic competence, knowledge of topics and reasoning ability are among other factors that determine students' level of reading comprehension (see Burton, 2014; Campo-Engelstein & Johnson, 2014; Osborne & Wellington, 2001 for a more extensive discussion of this issue). Moreover, in bilingual societies such as Jamaica, students' reading difficulties are increased as they must transpose concepts from one language to another (Soyibo & Thorpe, 1995).

### **1.8 Visual representation and science textbooks**

Over the last few decades, there has been considerable research interest on representations in science education from diverse perspectives. For example, some researchers have explored the visual character of science and the kinds and functions of visual representations in learning scientific ideas (Martins, 2002; Roth et al, 2005; Slough et al, 2010). Other studies have focussed on the use of multimodality in teaching and learning within contemporary science classrooms (Bezemer & Kress, 2008; Jewitt, 2008; Lemke, 2000). Still others (Cook, 2011; Lopez & Pinto, 2017; Pozzer-Ardenghi & Roth, 2003) have examined the difficulties students face in reading images. In other studies, the pervasiveness, functions and structures of visual representations in high school science textbooks have been the focus (Roth & Pozzer-Ardenghi, 2003). Indeed, the amount of research effort devoted to the analysis of visual representation gives some indication of the importance many researchers have attached to the messages that images can convey.

Although these studies offer important theoretical and practical insights into the role played by visual representations, including how they work in cooperation with other semiotic modes, in science classroom discursive practices, they have tended to concentrate on the pedagogic functions of visual representations in school science textbooks. Very little research in science education has specifically considered how students interact with and interpret the socio-cultural dimensions of the visual representations of textbooks. Nor has any research extended to what Apple (2004) describes as the 'latent messages' underlying the textbook portrayal of different groups in the Jamaican context.

Thus, to address some of the concerns raised in the above discussion, this research considers the socio-cultural elements of visual representations in the science textbook. Such an analysis is worthwhile to consider for the following reasons. First, as I have previously mentioned,

images of science exhibit an increasingly prominent role in science texts. This rise in the imagistic dimensions of textbooks has also resulted in a critical shift in the cultural significance attributed to visual imagery. Indeed, textbooks are now seen as key repositories of cultural values and meanings (Apple & Christian-Smith, 1991). The shift in cultural significance has influenced modern science textbooks which are now more contextualised with rich and diverse visual dimensions that not only promote conceptual understanding but also provide students with cultural representations of social identities and roles. Moreover, through these visual elements, students may develop a multicultural perspective of the world and are sensitised to issues of national and cultural identities.

Second, and related, outside of science education, authors such as Apple (2004) and Sleeter and Grant (2008) have drawn specific attention to the relationship between the curriculum and pedagogy that is found in formal institutions of education and unequal power in society. These scholars, through the lenses of cultural studies and post-colonialism, have also considered the relations between visual representations in textbooks and social variables such as race, class and gender. They have concluded that debates about curriculum content represent the struggle for power between social groups. More worrying, these authors have demonstrated definitively that there has been little change in the racial, social class, gender, disability and other categories of inequalities that exist in school textbooks. Although these studies were conducted in the United States, the findings have worrying and far reaching consequences for Jamaica, where persistent evidence indicates that social inequalities are reinforced through the visual representations in media (see, for example, Bailey, 2004).

Thirdly, while it is extremely difficult to substantiate the argument that the science textbooks that students read influence the construction of their social realities, textbooks must be understood as representational systems through which cultural messages about the characteristics of members of various social groups are transmitted. Such messages are created and circulated by the society's dominant culture and are prejudiced in favour of its cultural norms, stereotypical assumptions and attitudes and, thus, should be interrogated as to how they construct social realities in respect to the perspectives of minority group members. Moreover, curriculum materials such as textbooks can only be considered accessible if fair and accurate coverage is given to particular topics and social groups. Thus,



lack, under-representation or misrepresentation of minority groups in science textbooks can imply to students that science is not the normal pursuits of these groups (Elgar, 1999).

The basic, underlying themes here are that school science textbooks must not only be viewed as pedagogical tools but also as cultural objects that may affect (reinforce or ameliorate) inequalities in the science classroom and in the wider society. Furthermore, textbook culture during the last two decades has been marked by volatile reconfigurations in the relations of some social variables (e.g. gender) and representations. Though welcomed, these shifts and developments have been thrown into the foreground of contestation and debates by scholars, some citing issues of structural marginalisation, hegemonic influences, negative figuration, simplification and stereotyping of certain groups (Apple 2004; Sleeter & Grant, 2008). This situation, I suggest, raises further questions of representational democracy in school textbooks and may have wider implications for accessibility. However, despite these debates, very little research in science education has specifically considered how students interact with and interpret the socio-cultural dimensions of the visual representations of textbooks. Indeed, I found no research which explored the ways science textbook publishers pictorially construct images of race and gender in the Anglophone Caribbean context. Thus, the present study aims to address these gaps by examining the representation of race and gender through the images that are published in the science textbook. Race and gender are discussed below.

Furthermore, research has shown that in some countries, textbooks are often used to create a common national identity by marginalising, or in some instances, demonising groups not considered part of the constructed national narrative (Cajani, 2008; Challand, 2009; Vickers, 2006). Vickers (2006), for example, has demonstrated how history textbooks in China are used to reinforce the vision of 'one China' by misrepresenting the histories of the people of Mongolia, Hong Kong, Taiwan and Tibet. Such textbooks misrepresentations are not particular to China or history textbooks, much critical research has pointed to further examples in other educational systems (see, for example, Challand, 2009). It is for these reasons that this research also examines how one marginalised group in Jamaica, Rastafari, is represented in the science textbook under investigation. Rastafari is discussed below (Section 1.9).

## 1.9 Race

In sociological and anthropological literatures, the concepts of race and ethnicity have been highly contested and remain problematic. Whilst some scholars view race and ethnicity as indistinguishable (see, for example, Fenton, 2010), there seem a clear consensus that the two constructs are conceptually distinct and should not be used synonymously (Guo et al, 2014; Senior & Bhopel, 1994; Warren et al, 1994). These latter writers have argued that one's race and/or ethnicity should be treated as an affiliation rather than a genetic predisposition and individuals should be extended the respect of being allowed to specify the affiliation(s) of their choosing, in a way that suits them (Garcia, 2017). Glasgow (2009) argue that the best way to understand race and ethnicity is to view them as social constructs influenced by social and political factors. In this sense, boundaries of race and ethnicity may be fluid and subject to multiple determination and may change over time.

Fenton's (2010) review of the differences between race and ethnicity, cited in sociological scholarship, is relevant to this research: race is founded on biological traits – phenotypic differences in skin colour, hair texture and other physical attributes and ethnicity is most commonly used as a social-political construct that includes shared origin, shared language, and shared cultural traditions and customs. In respect of the above definition, it could be argued that in Jamaica, the ethnicity paradigm as a criterion for sorting individuals into various groups based on photographs and illustrations in science textbooks would be problematic and tenuous since most people have a shared culture and similar customs. In contrast, conceptualisation of race based on visible physical appearance as markers of difference seems a more pragmatic approach. By adopting this approach, I am by no means dismissing the veracity of sociological and scientific literatures that have consistently demonstrated that race is not a biological phenomenon but rather a social construction that ascribes meaning to aspects of human physiognomy (Bohnam et al, 2005). However, I believe in the context of Jamaica, the concept of race, defined in terms of phenotypic difference in skin colour and hair texture, has an extremely important and highly contested social meaning. Thus, it is worthy of consideration.

### 1.9.1 *Race and Jamaica*

During the post-colonial period, Jamaica's ruling classes constructed what is now considered as the national motto – 'Out of many, one people'. This slogan expresses a deep

understanding of the diverse heritage of the population that emerged during the colonial period. It also reflects the diversity of the Jamaican people, being a mix of different races, cultures and religions. Moreover, it promotes the ideology of Jamaica being an egalitarian and a classless society in which different racial groups worked in harmony. However, despite this projected image of a raceless nation, some social scientists (see, for example, Chevannes, 1994; Gordon, 1988) and social groups such as the Rastafari Movement Association (1976) have dismissed the national motto as hypocritical and pretentious, claiming instead that far from reflecting the unification of race and class through assimilation, the motto serves to strengthen the divide between Jamaica's races. Other scholars such as Alleyne (1996) argue that the ideology as expressed in the Jamaican motto represents to some degree a denial of, and distancing from, the concrete reality of the dominance of Black in the racial composition of Jamaica. As in all other Caribbean territories, in Jamaica stratification based on race remains, albeit there is ample evidence of its diminution in recent times: European Jamaicans over African Jamaicans, and in between them a range of subtle gradations of colour and status.

### **1.10 Gender**

The rift between race and social class in post-independence Jamaican society masked hierarchical relations of gender, which were essentially achieved through an intentional sex segregation of the curricula offered in both tiers of the education system that ensured differential socialisation of males and females into gender-related roles (Bailey, 2004). Lower class girls were taught sewing and plain needlework, with the hope that they might become reasonably competent seamstresses (Bacchus, 1994). Lower class boys were taught so that they could become more efficient in the *cultivation of the soil*, after they left school (Dunkley, 2011). This attempt to link practical experience with relevant classroom instruction, so as to make the industrial education programme largely self-supporting, was considered a particularly attractive feature of the proposal. Middle class girls were groomed to be good wives, clerical workers or teachers, while boys from this social group were prepared for commerce and politics, among other things.

Since the very beginning of formal education, race, class and gender have had this basic interlocking hierarchy, determining differential access to educational resources and knowledge. Thus, according to Bailey (2004), the distribution of both material and symbolic

power associated with the 'educated man' was regulated through systems of education explicitly structured and organised in ways intended to maintain the white, male upper class status quo; this, despite sporadic pockets of resistance exerted by subordinated groups, remained intact up until the turn of the 20<sup>th</sup> century. Education, established as the means of social cohesion in post-emancipation Jamaican societies, was paradoxically at the same time structured and organised in ways that were deliberately divisive and exclusionary.

Consequently, the general picture is that both in society and in education men are more numerous in the upper echelons of the Jamaican social structure and the school systems (Miller, 1991). On the other hand, women increasingly tend to occupy more of the middle positions in both society and the school system. Both the social structure and the school system are marked by gender differences in various segments, indicating the marginalisation of women. These gender patterns have become much more prominent and generalised in the post-war and post-independence period of Jamaica's history (Miller, 1991).

### **1.11 Rastafari: An overview**

The history and sociology of Rastafari in Jamaica has been the subject of much research and debates since the early 1960s (see, for example, Nettleford, 1970; Smith et al, 1967). There is general agreement amongst scholars that the social, economic and political circumstances of 1930s Jamaica gave rise to the Rastafari movement and their vituperation against white colonial rule (Stone, 1973). Indeed, a few scholarly works have documented the Rastafari struggle to liberate themselves, the wider Jamaican society, and that group that the Rastafari considers the 'community of sufferers' (Edmonds, 2003). (A comment on my use of the term Rastafari: Rastafari believe that "isms" represent the corrupt 'Babylonian' system that oppresses people; thus, they vehemently reject the use of the term 'Rastafarian' or 'Rastafarianism'. My use of 'Rastafari' denotes the subculture, as well as members within the subculture (as a noun), and is also used to describe the characteristics of the subculture. This treatment is consistent with that of Brithwright (2011) and Chevannes (1994)).

In his exploratory work on Rastafari from within a black theological context, Middleton (2015) argues that the Rastafari movement began as a social stand against white rule and the middle-classes, and now represents a communal mode of resistance, that is, resistance to racist ideologies, oppression, marginalisation, and class prejudice, as well as resistance to social

injustices, and the various other forms of closure that exist in any society. As such, Rastafari was rooted in the rejection of the legitimacy of the then Jamaican social order and in resistance to its values and social arrangements.

This argument is not new. Murrell (1998) rearticulates this line of reasoning and goes a step further to explain that the ideology of Rastafari has, over time, become the single most influential ideological force in Jamaican society. The scale of its social impact has made it central to understanding the history of oppressive slavery, the consequences of racism, and the permanent thrust for dignity and self-respect that is being undertaken by black people all over the world. Eldon Birthwright (2011), who seems to support Murrell's view, describes the Rastafari movement as a cultural glue that fosters community resistance. Birthwright's argument, for the most part, is reflective of what Yawney (1976) describes as Rastafari "power to focalise and even mediate certain socio-cultural tensions that have developed on a global scale" (p. 232).

#### *1.11.1 What do Rastafari believe?*

Leonard Barrett in his seminal 1988 work, *The Rastafarians: Sounds of Cultural Dissonance*, highlights six essential tenets of Rastafari, all of which challenge the establishment in an ongoing fight to overcome a complexity of oppressions ranging from the persistent ideologies of colonialism, slavery, and imperialism, to poverty, social injustice, and political misrepresentation in modern Jamaica. Thus, according to Barrett, Rastafari advocate that:

- Haile Selassie is the living God.
- The black person is the re-carnation of ancient Israel, who, at the hand of the white person has been in exiled in Jamaica.
- The Jamaican situation is a hopeless hell. Ethiopia is heaven.
- The invincible Emperor of Ethiopia is now arranging for expatriated persons of African origin to return to Ethiopia.

Furthermore, Rastafari believed that by being taken to the Caribbean by slave traders they had been robbed of their African heritage, which they sought to recapture and celebrate. For Rastafari, the bible is a sacred text, albeit it is interpreted in an afro-centric way, to reverse what they consider as changes made to the text by white powers. Indeed, one could argue that the re-interpretation of the Hebrew bible, with a focus on the black race as God's chosen

race, coupled with the belief that the true Messiah comes to us as the Ethiopian emperor, Haile Selassie, are central to their core belief, albeit there appear to be diverse opinions regarding the divinity of Haile Selassie. For instance, some groups within Rastafari believe that he is the Trinity (Father, Son and Holy Ghost), while other groups perceive him as the father of Jesus the Christ.

Essential to the discussion of Rastafari ideology is the powerful influence of Jamaican sociologist Marcus Garvey and his Universal Negro Improvement Association (UNIA) movement in the early twentieth century. Garvey, a committed Afro centrist, advocated a 'back to Africa' cause and underscored the need for black people to interpret their own history and control their destiny in Africa. He embraced the idea that Africa was the "cradle of the black race and that its contributions to development of civilization were paramount to the realisation of racial equity for the black diaspora" (Murrell et al, 1998, p. 42). This message resonated with a large section of Jamaica's working class people and, through extensive spoken discourse, Rastafari provide a voice for the poor black people, by encouraging resistance to oppressive societal structures.

### *1.11.2 Attitudes towards Rastafari*

During the 1960s and 1970s, perceptions and representations of Rastafari culture were of an "unsanitary-looking, useless, lazy, half-insane, ganga-smoking, illiterates who were of no value to the society" (Edmonds, 2003, p. 30). These portrayals were constantly reinforced in the print media, on television, and on fiction shows and significantly contributed in shaping the public views of and attitudes towards Rastafari. For instances, in the highly-acclaimed Hollywood movie, *Mark for Death*, regarded as insalubrious and offensive among Jamaicans, Rastafari characters are portrayed as religious zealots and a brutal segment of the Jamaican 'posse' that have links with obeahism (Dunkley, 2013). Even in the 'Jamaican public spheres', invoking Habermas, Rastafari have not been spared from such stereotypical depictions. Take, for instance, the idiom of reggae – often described as a mode of resistance within the social consciousness of 'subordinate' classes – Rastafari are often ridiculed and categorised as treacherous criminals who should be jailed or hung for their traitorous acts against the

Jamaican people<sup>8</sup>. Thus, the reggae idiom has further embedded the stereotype in the Jamaican psyche.

In writing about attitudes towards Rastafari, psychologist Leahcim Semaj (1980) noted that the dominant position of the public towards the Rastafari movement was “the damn Rasta dem, wey de Rasta dem want, we just put dem in a damn boat and put dem out in the sea and sink the boat – sey dem want to go Africa” (p. 40). Such attitudes and intolerance persist today and, as such, Rastafari have been the minority group most discriminated against in Jamaica, as attested by surveys published throughout the last three decades (see, for example, Gilroy, 1993; Singh, 2004).

### **1.12 Rationale for the research**

In his comparative examination of three-school biology textbooks used in the Anglophone Caribbean countries, Kola Soyibo (1996) reported that the biology texts were difficult for the target students to read and understand. He found that not only did technical vocabulary pose comprehension challenges but also ordinary words, when used in non-commonsensical or metaphorical ways. Since then, several scholars have examined the language demands of other science instructional materials and have found similar results as those in Soyibo’s (1996) study. See, for example, Khine (2013), Lodge (2002), Yong (2010) and Taber (2015).

Unfortunately, the above-mentioned studies relied exclusively on the use of readability formulae and Cloze procedures which highlight difficulties readers experience in understanding text without reference to the cultural and social context of the readers. These studies have also failed to recognise the multi-modal nature of today’s science instructional materials and have thus ignored other communicative systems, which are also important in meaning making in contemporary science. Thus, their findings may be limited and should be interpreted with much caution, especially when one considers the complexities of the Jamaican linguistics context (discussed below).

### **1.13 Research Question**

It is, then, for these reasons that the main rationale for carrying out this study is to determine the extent to which Jamaican students can access the language demands of science

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<sup>8</sup> See, for example, Lieutenant Stitchie, *Natty Dread*, produced by Studio One, 1987.

instructions. By providing comparative data and results, research of this nature should help educators in the process of curriculum evaluation and, more specifically, in their selection of science instructional materials. Accordingly, one main research question was developed:

- To what extent are secondary school science instructions in Jamaica accessible to their intended audience?

#### **1.14 Structure of the thesis**

In Chapter 1, I discussed the Jamaica's educational system from current and historical perspectives by making two related arguments. First, I examined the impact of colonial policies in establishing education systems in the English-speaking Caribbean; policies which, I contended, were designed to meet the needs of the metropolitan rulers, and which systematically excluded the mass of the population. The second argument is one that discussed some of the education relics of the colonial past and explored the impact of these remnants on current practices in the field. It is not within the scope of this thesis to present a complete chronological history of all the developments of the educational system in Jamaica. This has effectively been done elsewhere (see Miller, 1995; Whyte, 1977). To locate and contextualised the discussion, however, a brief historical overview of the main trends in the history of education over the past one hundred and fifty years was outlined. The aim here was to construct a balanced analysis of the education system during and after colonialism. Additionally, an historical account of education and the language situation in Jamaica was offered as part of the interpretative background. It was presented as a precursor to the analysis of the data because such information tells us more about the actors, the situation from which they came, and the forces which have helped to form their opinions and judgement about science instructions in Jamaica.

Chapter 2 comprises a discussion on the conceptual and theoretical framework for the study. I present theoretical constructs from Halliday's (1978) systemic functional linguistics (such as the notions of metafunctions, context of situations and register) and discuss their implications for science instructions. The chapter also discusses the visual analysis framework developed by Kress and van Leeuwen (2006) and highlights its appropriateness as a social and cultural tool for analysing the science textbook investigated in this study. The importance of language of school science textbooks, which was raised in Chapter 1, is further developed.



Chapter 3 discusses the methodological considerations of the research. I explain why the multi-perspectival methodological framework selected fits the purpose of the research. Specific details about the data sources are highlighted to show how a robust and credible investigation is possible. The final section of this chapter turns to the question of ethics in the research. I identify and reflect on the core ethical guidelines which were used throughout the research process, including potential harms and benefits, along with issues of privacy and confidentiality.

The findings of the study are discussed in Chapters 4, 5, 6 and 7. An outline of the methodological procedures used to gather the data is presented at the beginning of each of these chapters. For example, Chapter 4 includes a description the procedure used in the analysis of the Cloze test and readability index, Chapter 5 contains the methods used in the visual representation analysis and Chapters 6 and 7 includes a description of the methodological procedures associated with grounded theory, including the technique I used for gathering the data. The chapters also include interpretations of the data.

In the final chapter, I reflect on the conceptual and epistemological framework upon which the research is grounded. Issues of validation are also discussed. I review the extent to which the research questions have been answered by summarising the main findings and interpretations. The chapter closes with a discussion of the recommendations arising from the findings, including suggestions for future research.

## CHAPTER 2

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### REVIEW OF LITERATURE

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#### 2.1 Introduction

The organisation of the research methodologies used to conceptualise the extent to which secondary science instructions in Jamaica are accessible to their intended audience will follow Halliday's division of what is linguistically significant in the context of situation. This approach is useful as a conceptual tool since it enables us to decode the semiotic properties of the situation in which science instructions exist. The first part of this chapter discusses the linguistic aspects of context of situation.

In Halliday's systemic functional linguistics, language refers to "natural, human, adult, verbal language – natural as opposed to designed semiotics" (Halliday & Mathiessen, 2013, p. 20). But, as Kress (2000) argues, "it is no longer possible to understand language and its uses without understanding the effects of other modes of communication that are copresent in any text (p. 337). For this reason, this study extends Halliday's 'grammar of a language' to the 'grammar of other semiotic modes' to examine the portrayal of race and gender in the science textbook. The visual grammar established by Kress and van Leeuwen (2006) is of importance to this aspect of the analysis and will also be discussed in this chapter.

Social semiotics by itself is not enough to explain the different ways that students make meanings of the race and gender of science textbooks and how these meanings are interrelated. Thus, to further explain the results from the analysis, the study draws on theories of cultural studies to consider the broader question of meaning, language and representation. Although numerous theoretical approaches have been used to examine issues of race and gender, and textbooks, I believe that cultural studies represent the most salient contemporary thinking on representation and culture. These issues are considered in this chapter.

Furthermore, school science textbooks were described in Section 1.6 as being one of the most important resources used in Jamaican science classrooms in making clear the learning progression within the subject. This chapter further examines issues concerning the language

of science textbooks, by reviewing the findings of some of the important studies done in this area.

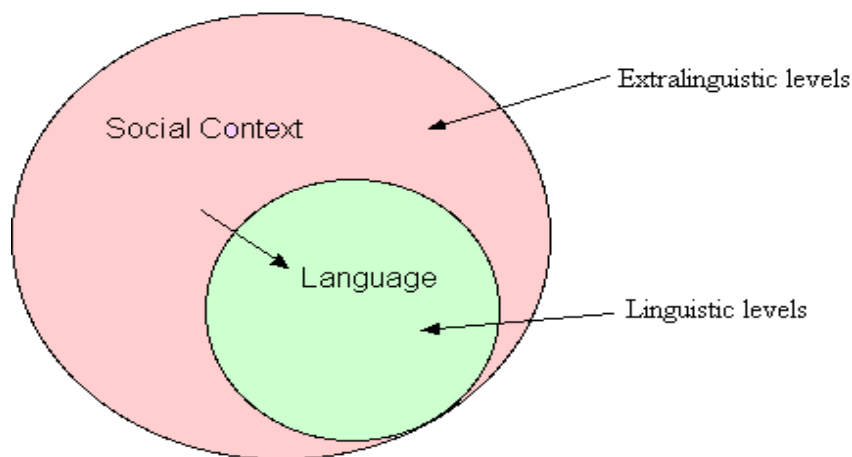
## **2.2 Systemic functional linguistics (SFL)**

Functional linguists such as Michael Halliday have advanced numerous theoretical frameworks for describing language in its social context in specific and elaborated ways. In particular, the theory of systemic functional linguistics (henceforth, SFL) proposed by Halliday in the 1960s and expanded in the last two decades through the work of many linguistics scholars (Christie, 2002, 2007; Lukin, 2012; Matthiessen et al, 2010; Kress & Van Leeuwen, 2001; Thompson, 2013) provides a theoretical and analytical framework that researchers can use to look systematically at relationships between form and meaning in the language used in different social contexts. The framework also offers a way of thinking about the relationship between the linguistics choices of speakers and writers in particular moments of interaction and the social contexts that the language help realise (Scheppegrell, 2004). Thus, through its emphasis on the functional basis of language structure and the view of language as meaning potential, SFL provides a useful tool to interpret science instructions in Jamaica with reference to its place in the social process.

As implied above, within the SFL perspective, language is seen as a systemic resource for making and exchanging means – as an information system, if that terminology is preferred. Halliday (1978) maintains that approaching language in this way means “interpreting language within a sociocultural context in which the culture itself is interpreted in semiotic terms” (p. 2). Such a characterisation would suggest that at a concrete level, language, as Gregory (1980) argues, is an inter-organism phenomenon (something happening between people) rather than an intra-organism phenomenon (something happening inside people). Moreover, the characterisation also points to the functional nature of language. Halliday (1975) identifies the following functions of language: to construe experience in terms of what is going on around us and inside us, to interact with the social world by negotiating social roles and attitudes, and to be able to create messages with which we can package our meanings in terms of what is *New* or *Given*, and in terms of what the starting point for our message is. Thus, in addition to interpreting language in semiotic terms, SFL also seeks to explain the nature of language of language in functional terms, that is, “seeing whether

language itself has been shaped by use, and if so, in what ways – how the form of language has been determined by the functions it has evolved to serve” (Halliday, 1973, p. 7).

In SFL, language is viewed as a semantic configuration of meanings that are typically associated with a particular context (Halliday & Matthiessen, 2013). Indeed, the category of context has played a crucial role throughout the development of SFL. According to Hasan (2009) context as a theoretical category is central to any coherent account of the nature and function of language, since every communicative act takes place in a ‘situational and cultural’ context. It is the context that determines what sort of language will be used. Language, therefore, cannot be separated from the context in which it is produced and which it is simultaneously construes. Essentially, what this implies is that language comes to life only when functioning in some environment. Figure 2.1 presents a summarised view of the relationship between language and context.



**Figure 2.1 Language and context – adapted from Martin (2001)**

### 2.2.1 Context of the situation

The phrase ‘context of situation’, which became a significant part of a theory of meaning during the 1960s, was first used by anthropologist Bronislaw Malinowski (1923) in his essay ‘The problem of meaning in primitive languages’ in trying to translate the ‘primitive’ (unwritten) language used by the Trobriand Islanders, in Papua New Guinea. He writes:

... in a primitive language the meaning of any single word is to a high degree dependent on its context. The words ‘wood’, ‘paddle’, ‘place’ had to be retranslated in the free interpretation in order to show what is their real meaning, conveyed to a

native by the context in which they appear ... it is clear that the meaning of the expression 'we arrive near the village (of our destination) ... becomes only intelligible when it is placed within its context of situation, if I may be allowed to coin an expression which indicates on the one hand that situation in which words are uttered can never be passed over as irrelevant to the linguistic expression. (p. 306)

In his later writings (see, Malinowski, 1935). Malinowski suggested that the context of the situation is not only a special feature of primitive languages but apply to all languages. Thus, he writes "the real understanding of words is always ultimately derived from active experience of those aspects of reality to which the words belong" (Malinowski, 1935, p. 58). For him, language is essentially rooted in the reality of the culture, the tribal life and customs of a people, and it cannot be explained without constant reference to these broader contexts. Words fulfil a social function and that is their main aim, but they are neither the result of intellectual reflection, nor do they necessarily arouse reflection in the listener (Malinowski, 1923).

Malinowski's ideas were developed and later popularised by Firth (1935, 1957a, 1957b) who considered Malinowski's formulation on context of situation as very significant in the development of linguistics, despite its lack of theorization. Although Firth was less interested in 'primitive' languages, but rather what he described as "typical texts in their context of situation" (Firth 1957a p. 224), he saw the possibilities of integrating Malinowski's context of the situation into a general theory of levels of language. Thus, he argued that the study of meaning and context should be central in linguistics (Firth, 1935). He proposed that the study of meaning was linked to all levels of linguistic analysis (phonetic, phonological, lexical, morphological, and syntactic) and must be treated with their contexts and situations. Later, some scholars (see, for example, Lyons, 1966) criticized Firth for stretching the meaning of 'meaning' and while 'situations', they argue, was important for the interpretation of text and speech, much more is needed to give a full picture of meaning.

Firth (1957b) proposed a set of concepts for describing the context of a situation. These descriptions underscore the importance of understanding language in relation to its social structure. The following is the description:

- The participants in the situation.
- The action of the participants.

- Other relevant features of the situation: the surrounding objects/events.
- The effect of verbal action; what changes were brought about.

The fundamental idea threading through this set of concepts, is that the ‘context of situation’ and text should not be treated as separate entities but rather should be “encapsulated in the text, not in a kind of piecemeal fashion ... but through a systematic relationship between the social environment on the one hand, and the functional organisation of language on the other” (Halliday, 1989 p. 11).

For Halliday, like Malinowski and Firth before him, the concept of context is central in determining the meaning making system of speech and text. In his influential 1971 paper, ‘Language in a social perspective’, he describes context as:

a construct of cultural meanings, realized functionally in the form of acts of meaning in the various semiotic modes, of which language is one. The ongoing processes of linguistic choice, whereby a speaker is selecting within the resources of the linguistic system, are effectively cultural choices, and acts of meaning are cultural acts. (Halliday, 1971 p. 165)

He proposed that a particular situation-type can be regarded as a semiotic structure represented as a complex of three dimensions: the on-going social activity; the status and role relationships involved; and the symbolic or rhetorical channel (Halliday, 1978). These dimensions are handled by the diatypic categories of *field*, *tenor*, and *mode* (Halliday, 1978, 1985a, 1989b, 1989c, 1994; Halliday & Matthiessen, 2013). These three variables are the determining factors for the linguistic features of a text and offer a system which helps illustrate any socio-linguistic occurrences.

According to Halliday (1978) field refers to what is happening to the nature of social activity that is taking place. It answers such questions as what it is that the participants are engaged in. The field is also concerned with the topic or focus of the interaction or activity and the degree of specialisation. It is realised through language in the choices of participants, processes and circumstances and the degree of the specialist lexis employed. Tenor relates to who is taking part, the nature of the participants and the temporary or permanent relationships between the participants. Mode refers to the channel of communication. That is, what part the language is playing and what is it that that participants are expecting the language to do for them in that situation. Mode also refers to how the text is produced:

spontaneous, prepared, performative or reflective. Additionally, it answers the question of what is being achieved by the text in terms of categories as persuasive, expository, and didactic. In the process of communication, the meaning system is largely determined by the three aspects of situational context mentioned above. Collectively, the three dimensions of situational context are called the register, which Halliday describes:

as the configuration of semantic resources that the member of a culture typically associates with language we speak or write in certain situations. It is the meaning potential that is accessible in a given social context. Both the situation and the register associated with it can be described to varying degrees of specificity; but the existence of registers is a fact of everyday experience – speakers have no difficulty in recognising the semantic options and combinations of options that are ‘at risk’ under particular environmental conditions. (Halliday, 1978, p. 111)

The notion of register clarifies the distinction between everyday language and the language of the science since scientific discourse has its own terminology and grammar (Halliday & Martin, 2003). Registers link text (oral, written, or visual) to their context. In addition, when viewed as semiotic components of the situation (although there is not total correspondence), field, tenor and mode are systematically related to the functional components of the semantics: field to the ideational function (language as content carrier), tenor to the interpersonal function (language as participation) and mode to textual function (actualising of the other functions (Gregory, 1980). Functional components are discussed further in the next section.

Undoubtedly, Halliday’s notion of the register has provided researchers with a useful parameter for linguistic analysis. However, it was criticized by some scholars, notably David Crystal in the 1970s. Crystal (1976) argued that the term was being indiscriminately applied to every possible variety of language. Crystal writes: “this term has been applied to varieties of language in almost indiscriminate manner, as if it could be usefully applied to situationally distinctive pieces of language of any kind” (Crystal, 1976, p. 61). Other critics have focussed on the lack of empirical basis for the claims for the three contextual parameters and the three corresponding metafunctions (Butler, 2003). In adding to the criticisms, van Dijk (2008) suggested that the SFL does not devote enough attention to analysing context, preferring to focus more on the lexicogrammar. However, despite these criticisms, the notion of the

register is of importance to this research since it provides the conceptual framework for the analysis.

### *2.2.2 Semantic components*

In the SFL tradition, language is interpreted as a tristratal system with a distinct organisation in terms of content: semantics and lexicogrammar are content strata and phonology is the expression stratum. Each of these strata is seen as a system of meaning-making potential. Thus, what the speaker can do is released through the linguistic or semantic potential, what the user can mean is released through the lexicogrammar potential and what the speaker sounds like is the result of the phonological potential.

As implied above, lexicogrammar functions to allow a language user to make linguistic choices within a specific communicative situation and context and for a specific purpose. Viewed from this perspective, it carries out the following three core functions: the function of organising the language users' experience of the world; the function of enacting social relationships; and the function of creating relevance to the context of situation (Halliday, 2004, p. 61). As a system which performs these three main functions, language is context-dependant, whereby lexico-grammatical and structural choices are determined by the context and the rhetorical purpose of the discourse in question. Approaching language as a system, SFL requires the analysis of the linguistic elements in a text as a system. Analysis of lexicogrammatical features without the linking of these to context will result in an incomplete understanding of how language contributes to the construction of meaning in a social domain. Viewing language as a system, which is constituted through its functions and realised in context, Halliday (2001) defines the three named functions as metafunctions, by means of which the linguistic system is organised. According to Halliday (2001), metafunctions are the organization of the content strata (lexicogrammar and semantics) into functional components: ideational, interpersonal and textual. In other words, they make up parts of the system that have to do with construing human experience, enacting social relationships, and creating discourse. The three metafunctions of language – ideational, interpersonal and textual – are closely interrelated and interdependent (see Table 2.1).



**Table 2.1 SFL –based model of ranks and levels of analysis and analytical categories adapted from Halliday (2004).**

Context and text	<p>context social practices broad socio-political discourse</p> <hr style="border-top: 1px dashed black;"/> <p>discursive practices: • translation (source/target) • accessibility (user/audience)</p> <p>intertextuality (internal and external)</p>	Interpretation and Evaluation		
Function	<p>metafunctions of meaning</p> <pre> graph TD     A[metafunctions of meaning] --&gt; B[ideational (experiential)]     A --&gt; C[interpersonal]     A --&gt; D[textual]     B --&gt; E[Transitivity]     C --&gt; F[Mood/ Modality]     D --&gt; G[Theme Cohesion Coherence]         </pre>			
Textual Realisation	<table style="width: 100%; border: none;"> <tr> <td style="width: 33%; text-align: center; vertical-align: top;">                 participants processes circumstances             </td> <td style="width: 33%; text-align: center; vertical-align: top;">                 modal auxiliaries mood types pronouns modal expressions             </td> <td style="width: 33%; text-align: center; vertical-align: top;">                 thematic structure reference conjunctions             </td> </tr> </table>		participants processes circumstances	modal auxiliaries mood types pronouns modal expressions
participants processes circumstances	modal auxiliaries mood types pronouns modal expressions	thematic structure reference conjunctions		

Halliday (2007) describes the ideational metafunction as the ‘content function of language’. It is concerned with examining the processes that are described and understood in language. It is in the ideational metafunction that the text-producer embodies in language their experience of the phenomena of the real world. According to Halliday (1985), the ideational metafunction has two modes, the experiential and the logical. The experiential metafunction corresponds to the construction of a model of experience and is realised by means of a clause as representation. The logical metafunction, viewed as an overarching abstract concept which unites all three metafunctions, sets up logical-semantic relationships between one clausal unit and another (Halliday, 2007).

The experiential metafunction is manifested through a system of transitivity. Halliday (1985) uses the term to refer to “the different types of processes that are recognised in the language, and the structures by which they are expressed” (p. 101). According to Halliday, the system of transitivity is represented as a configuration of three components which he refers to as a

‘transitivity process’, namely: processes (what kind of event/state is being described and is realised by a verbal group), participants (the entities involved in the process, realised by a nominal group) and circumstances (specifying the when, where, why and how of the process, realised by adverbial or prepositional groups). Halliday argues that these three components provide the frame of reference for interpreting the experience of what goes on. Take, for example, the following expression: *A duck is walking across a pond*. In terms of transitivity, a fragment of experiences has now turned into a meaning structure and is now constructed as a configuration of a participant (a duck), a process (walking) and a circumstances (a pond).

Logical meanings concern the ability to make explicit certain fundamental relations and are encoded in clause complexes, in which ‘clusters’ of clauses and the experiential meanings combine to form elaborate inter-clause messages. Such clauses can be described in terms of their interdependency as either paratactic (linked in a relationship of equality, e.g. Jack fell down and broke his crown)<sup>9</sup> or hypotactic (linked in a relationship of unequal status, e.g. Jill fell down because she slipped)<sup>10</sup>.

The interpersonal metafunction deals with participatory function of language. In other words, it is concerned with the type of interactions taking place and the kinds of commodities being exchanged (Thompson, 2004). Here, language is in an ‘active’ mode, since it is being used to enact social and personal relationships with people around us. The interpersonal metafunction is realised by what Halliday (1970, 2004) describes as ‘mood’ and ‘modality’. The system of mood is the system of grammar that is related to the interpersonal metafunction and is seen as a resource for describing the choices underlying the exchange of information at the clause level and the structuring of dialogue between participants. According to Halliday (2004), the mood consists of a subject and a finite and it is these elements that determine whether the clause is declarative or interrogative.<sup>11</sup> Modality refers to the degree of certainty and truth of statements about the world. It serves, according to

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<sup>9</sup> Here, all the clauses carry the same weight: the relationship between them is supplied by the reader, based on the context.

<sup>10</sup> In this example, the clauses have an unequal relationship since the second clause is dependent on the first dominant clause.

<sup>11</sup> In a declarative clause, the speaker is giving some information to the hearer. In an interrogative clause the speaker assumes the role of asking for information (see Halliday, 2013).

Aijmer (2016), “to establish and maintain social relations for the expression of social roles, which includes the communication roles created by language itself” (p. 5). In this sense, modality is closely linked with the mood system discussed above. Halliday and Matthiessen (2013) points to three basic values of modality: high, median and low. These three values indicate the degree of certainty about the validity of a proposition.

The third metafunction, the textual metafunction, has a distinctive part to play in the overall creation of meaning (Halliday, 1973). It is the textual metafunction that makes the difference between language in the abstract and language in use. In other words, as Halliday (1977) points out, it is through the semantic options of the textual component that language comes to be relevant to its environment. According to Halliday (1978), it “is only in combination with textual meaning that ideational and interpersonal meanings are actualised” (p. 113). Specifically, the textual metafunction constructs ideational and interpersonal meanings as information that can be shared by speakers and listeners by providing the resources for guiding the exchange of meaning in text. However, whilst the ideational and interpersonal functions operate at the clause and sub-clause level, the textual operates across clauses, making language cohesive and coherent.

A major component of the textual metafunction is the concept of ‘theme’. A theme is described by Halliday (1994) as a universal element which serves as the point of departure of the message. Its main purpose is to “locate and orient the clause within its context” (Halliday & Mathiessen, 2013, p. 64). Thus, it is theme that offers a view on the structure of clauses, as well as of smaller and bigger units which can be assigned a thematic structure. In doing so, it provides the ‘glue’ that structures and binds the ideational and interpersonal meanings. With respect to the English language, Halliday (1994) acknowledges that themes are realised by what is placed in the initial position within the clause and this initial position gives the theme a special status with the clause.

Halliday’s conception of theme has been criticized by some linguistics scholars who suggest that his treatment of the concept is ‘obscure’ and ‘unelaborated’. For example, in probably the most unfavourable review of the first edition of Halliday’s 1985, *Introduction to a Functional Grammar*, Hudson (1986) wrote:

There are many places in the book where he makes a claim which I, for one, was completely unable either to agree with or to disagree with because the categories

concerned were so vaguely defined ... Take the important category 'theme', for example. The following definitions are provided: 'The theme is what the clause is going to be about' ... 'The Theme is what the speaker selects as his point of departure, the means of development of the clause' ... Presumably he finds these definitions adequate, because he is able to pick out the themes in any clause and work out the general rules which govern their use – for example, 'The Theme of any clause ... extends up to (and includes) the topical Theme. The topical Theme is the first element in the clause that has some function in the ideational structure (i.e. in transitivity ...)'. Perhaps he is tuned into language in a way that the rest of us are incapable of, but those of us who can't easily pick out the parts of a clause which define 'what it is going to be about', or its 'point of departure' are simply unable to decide whether any of his claims about themes are right or wrong. (p. 798)

### **2.3 Social semiotics**

The concept of social semiotics has been used to conceptualise meaning-making in practices of representation and communication in classrooms and has come to occupy a new and important place in current science education scholarship (Bezemer & Kress, 2008; Jewitt et al, 2001; Kress, 2010; Lemke, 1997, 2008; O'Halloran, 2011). For some, social semiotics represents a dynamic and distinctive approach to the practice and theory of representation (van Leeuwen, 2005) and has provided many researchers with a framework for examining the social dimensions of meaning-creation and the power of human processes of signification and interpretation in shaping individuals and societies (Chandler, 2007). This approach challenges the dominance of the spoken and written language in research by providing a framework for the collection and analysis of visual, verbal, and aural aspects of interactions and environments.

Furthermore, as Kress (2010) reminds us, meaning-making is produced, interpreted, expressed and circulated in social contexts, which are permeated by forces of power and domination. Such forces, Kress (2011) argues, shape the discursive practices of the social agents who participate in the various communities. Social semiotics, therefore, draws attention to the fact that meanings always relate to specific societies and their cultures and to the meanings of the members of those cultures. In doing so, it attends systematically to the social, political, and cultural interpretation of meaning-making in a wide range of modes

of communication. It seems appropriate, then, that this study draws on the ideas of multimodal social semiotics orientation (Kress & van Leeuwen, 2006) to conceptualise how the science instructions in the Jamaican classroom seeks to make visual representation of people in the context of their cultural, social and psychological history.

### 2.3.1 Ferdinand de Saussure

The social constructionist view of representation as conceptualised and discussed in this research owes a great deal to the ideas and influence of structuralist linguist Ferdinand de Saussure. In the context of this study, Saussure's relevance lies not in his detailed development of structural linguistics but in his general view of language as a social phenomenon and how systems of representation work in the production of meaning. Indeed, the Saussurean notion of language as a system of options and meaning potentials represented a radical change from previous approaches and has shaped the multimodal approach to the problem of representation within a range of critical and descriptive discourses.

In his book, *Course in General Linguistics* (1916), described by some scholars as one of the seminal linguistics works of the 20<sup>th</sup> century, Saussure called for "a science that studies the life of sign within society" (Saussure, 1916, p. 16). The central argument developed throughout the book was that language operates as a system of signs used in human communication. For Saussure, modes such as images, music, written words etc. function as signs within language only when they serve to express or communicate ideas. However, he cautioned that for signs to operate as meaning-makers, they must be part of a system of shared codes and conventions. Moreover, according to Thibault (1997), Saussure also demonstrated that meaning-making within a "language system is not comprised of individual speaking subjects or of individual uses of signs; rather, *langue* (language) is a system of social conventions which are adopted by the 'social body'" (p. 77, italics in original).

Saussure's analysis of language as system of signs also included two further elements that are noteworthy in this assessment. He posited that signs are composed of two basic building blocks: the signifier (the form which the sign takes) and the signified (the concept it represents). He argued that meanings or significations are produced through the relationship between the signifier and the signified. For Saussure, the signified is a mental construct that is formulated within a social and cultural context. In other words, the signified in one culture

may not carry the same meaning or representation in another. For example, the word *black* may carry a negative conception in some cultures and a positive one in others.

Saussure's assertion that the relationship between the signifier and the signified was not permanently fixed, but is subject to historical change, is also salient to this discussion. Representations, as Saussure noted, shift meaning according to different historical moments. What is especially interesting here is that Saussure saw the relationship between the signifier and the signified as arbitrary and conventional. Thus, as Hall (1997) argues in his critique of Saussure's model:

... there is no natural or inevitable link between the signifier and the signified. Signs do not possess a fixed or essential meaning. What signifies, according to Saussure, is not *RED* or essence of 'red-ness', but *the difference between RED and GREEN*. Signs, Saussure argued are members of a system and are defined in relation to the other members of the system. (p. 31, italics in original)

Some scholars (see, for example, Koster, 1996) have argued that Saussure contributed very little to a general theory of signs. There is some truth to this argument, since his writings had little to say about non-linguistic signs and he was not concerned with the general topology of signs. Nevertheless, Saussure's work can be considered pioneering since it drew many scholars' attention to language as a social phenomenon and provided a model of representation which has been applied to a diverse range of cultural practices. In this respect, his writings have provided powerful theoretical and descriptive resources for the study of meaning and communication and have inspired scholars such as Rudolf Arnheim, Roland Barthes, Michael Halliday, Charles Morris, and Valentin Voloshinov, albeit in different ways.

Perhaps more importantly, Saussure's model provided the foundations of social semiotic and multimodality research by offering a set of generative theoretical tools with which to conceptualise and describe representation in the classroom as demonstrated by the works of researchers in the field (see, for example, Hodge & Kress, 1988; Kress & van Leeuwen, 2006) and it is to a discussion of this that I now turn.

### 2.3.2 *Social semiotics and multimodality*

The above discussion highlights the importance of Saussure's legacy in drawing attention to language as a social process and how language works in creating meaning in the process of

representation. Central to this argument is the notion of the arbitrary relationship between the signified and the signifier. Indeed, some critiques (see, for example, Hall, 1997) have argued that Saussure's narrow focus on these two aspects of the sign diverted attention away from "the more interactive and dialogic features of language – language as it is used, as it functions in actual situations" (Hall, 1997, p. 35). In this sense, questions of power and hegemony were not addressed. Others have pointed out that Saussure's structuralist semiotics did not address questions of how societies and cultures maintain or shift the conventional bonds between the signifier and the signified (Hodge & Kress, 1988). It is these questions that social semiotics and multimodality try to address by examining the social dimensions of meaning-making and explaining "how the social shaping of meaning works in practice" (Hodge & Kress, 1988, p. 22).

Social semiotics and multimodality takes as its starting point that that all signs and messages are carriers of cultural values and significance, and therefore should be situated within the context of social relations and processes. In so doing, this approach builds on the social functional perspective of language (discussed earlier in this chapter) but moves beyond written and spoken language to include the full repertoire of semiotics modes, which individuals or communities use to make meaning. It is these modes, Kress (2010) argues, that are constitutive of the material means, and which have been socially and culturally moulded by different communities into semiotic resources. This position is fully encapsulated in Hodge and Kress' *Social Semiotics* (1988) and later in Kress and van Leeuwen's *Reading Images: The Grammar of Visual Design* (2006).

In another departure from Saussure's model, social semiotics replaces the principle of 'arbitrariness' to one of 'motivation' in all instances of sign making, for any kind of sign (Hodge & Kress, 1998). This position is captured in Kress (2011) in which he describes signs used in social semiotics as "*motivated* conjunctions of form and meaning, the product of the sign-maker's agency, and as representing her or his *interest* at the moment of the making of the sign" (Kress, 2011, p. 209, italics in original). Kress's use of the term *motivated* here is of importance. Kress argues that Saussure's use of the term 'arbitrariness' in describing the relation of signifier and signified was an overstatement and "goes directly against the notion of the sign-maker's interest in the making of signs and meanings" (Kress, 2010, p. 63). For Kress, the relationship between a signifier and a signified is always completely accessible to a

particular person in a particular place and time with a particular interest. Kress believes that the terms 'arbitrariness' and 'motivation' of signs are formulated on social principles. Thus, he writes:

... arbitrariness points to the strength of social power as convention and motivation points to plausibility and transparency of the relations of form and meaning in the sign. ... Convention points to social agreement and power in sign-use. Motivation points to the need for transparency as a means towards shared recognition in the relation of form and meaning in communication. (Kress, 2010, p. 64)

Kress's social semiotic approach to representation highlights the potential for individual, social and cultural agency and change and makes a radical shift from conventional approaches in which language is seen as independent of, and pre-exists, individual users. In doing so, it opens up meaning and representation to constant transformations and interpretations as individuals' creativity, social identities, and historical circumstances changes. Indeed, what constituted a representation fifty years ago may look quite different from the depictions in modern textbooks. The implications of this argument are far-reaching for a theory of representation and for our understanding of social and cultural organisation.

To understand the material and the cultural, social and historical conditions of the possibilities of meaning making in visual representation, the notion of 'affordance' from multimodality is of importance in the context of this research. The term affordance is used by social semioticians (see, for example, Kress, 2010) to refer to the potentialities and limitations of different modes. Writing about semiotic resources, van Leeuwen (2005) argues that all modes have a theoretical semiotic potential (constituted by all their past uses) and an actual semiotic potential (constituted by those past uses that are known to and considered relevant by the users of the mode and by potential uses that might be uncovered by the users according to their specific needs and interests). Thus, since all instances of representation takes place in a social context, different contexts may have different rules or best practices that regulate the ways in which specific semiotic resources can be used. So, affordance in this context is shaped by the different ways in which a mode has been used, what it has been repeatedly used to mean and do, and the social conventions and material possibilities that inform its use in context.



The framework used in this analysis of the visual representations draws heavily on the writings of Kress and van Leeuwen (2006). In *Reading Images: The Grammar of Visual Design* (2006), these authors draw on the broad semiotic aspects of Halliday's (1978, 1985) SFL theory (see Section 2.2) to outline a framework for the development of a visual grammar and to articulate the kinds of categories which they regard as essential to the analysis of the visual semiotic. They argue that "the visual, like all semiotic modes, has to serve several communicational (and representational) requirements, in order to function as a full system of communication" (Kress & van Leeuwen, 2006, p. 40). By applying Halliday's SFL and the metafunctional hypothesis in particular, to other semiotic modes, an underlying assumption in Kress and van Leeuwen approach is that visual images also draw upon the same semantic systems as language in realising meaning potential. Moreover, as Kress and van Leeuwen (2006) noted, while visual modes differ in terms of the ways in which choices from the social semantic system are realised, "the semiotic code of language and the semiotic codes of pictures [and other visuals] each have their own quite particular means of realising what in the end are perhaps quite similar semantic relations" (p. 44).

Halliday's three metafunctions were discussed at length in *Section 2.2.2* but in the context of this discussion maybe summarised briefly as follows:

- Ideational metafunction – the function for constructing human experience.
- Interpersonal metafunction – the function of constituting social interactions.
- Textual metafunctions – the function for the internal organisation and cohesion of text.

These categories were adapted and usefully applied to the analysis of images by Kress and van Leeuwen (2006). For reasons, that were not evidently clear the categories were renamed from ideational to representational meanings, from interpersonal to interactive meanings and from textual to compositional meanings. However, much of the lexicogrammatical terminologies utilised by Halliday in *Introduction to a Functional Grammar* (1985) was adopted by Kress and van Leeuwen in *Reading Images* (2006). For example, the system of transitivity used by Halliday (1985) to refer to the kinds of 'doings' and 'beings' that constitute human experience is also used by Kress and van Leeuwen in a similar way in the analysis of visual grammar with one caveat. While Halliday's transitivity system composed of six processes (material and behavioural, mental and verbal, existential and relational) to

represent the ideational content in verbal language, visual grammar offers two main dynamics: narrative and conceptual (discussed in the next section). There is also similarities in the use grammatical system of modality. In both Halliday's SFL and Kress and van Leeuwen social semiotic formulation, modality "refers to the status, authority and reality of a message, or to its ontological status, or to its value as truth or fact" (Hodge & Kress, 1988 p. 124).

### *2.3.3 Representational meaning*

Central to representational meaning is the idea that any semiotic mode must be able to represent aspects of the world as it is experienced by humans (Kress & van Leeuwen, 2006, p. 42). Thus, it deals with the representation of experiences and the connections between them. Kress and van Leeuwen (2006) noted two kinds of participants that one must consider when analysing images: the interactive participants and the representational participants.<sup>12</sup> The interactive participants are the people who communicate with each other in the act of reading a visual, the producers and the viewers. This element represents the social relations between the viewer and the visual. The represented participants are those elements that are present in the image. Both these two types of participants are connected through what Kress and van Leeuwen (2006) called 'vectors', which often, though not always, take the form of sight lines between represented participants or between represented participants and interactive participants.

In the representational structure described above, Kress and van Leeuwen (2006) posited two major processes for representing interactions and conceptual relations between people, places and things in visuals: narrative and conceptual processes. These categories are summarised in Table 2.1. Narrative represents "unfolding actions and events process of change, transitory spatial arrangements" (p. 79). Whilst conceptual "represents participants in terms of their more generalised and more or less stable and timeless essence" (Kress and van Leeuwen, 2006, p. 79). Narrative structures are realised by using vectors, i.e. a depicted element which forms an oblique line and indicates directionality (see Kress & van Leeuwen, 2006, p. 59). Thus, depending on the vectors used and participants involved, narrative processes can be built by what Kress and van Leeuwen (2006) describe as action or reactional

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<sup>12</sup> Kress and van Leeuwen (2006) use 'participant' to mean a construction element used in an image. This might be an object or element.

processes. Action processes are realised by vectors originating from one participant and directed at another whilst in the case of reactional processes the vector is formed by the direction of the glance of one or more participants. In reactional processes, the structure can be transactional (when the glance is directed towards another participant) or non-transactional (when the glance is directed towards something outside the picture frame).

Apart from processes and 'represented' participants, narrative structure also contains secondary participants, which Kress and van Leeuwen (2006) describe as circumstances. In this study, circumstances of setting describe the location of the participants. Circumstances of means refer to the tools used in the action processes such as laboratory equipment. Circumstances of accompaniment refer to situations in which participants are not linked by a vector.

As for conceptual structures, three dimensions were identified by Kress and van Leeuwen (2006): analytic, symbolic and classificational. Analytic processes relate participants in terms of a part-whole structure. They involve two kinds of participants: the carrier (representing the whole) and any number of possessive attributes (the parts) (Kress & van Leeuwen, 2006). At the same time, symbolic processes explore what a participant in an image is or means. This is broken down into two further categories: symbolic attributive and symbolic suggestive. According to Kress and van Leeuwen (2006) symbolic attributive process deals with the relationship between the carrier and the symbolic attributive. In other words, a participant comes to represent something other than the participant itself. In contrast, symbolic suggestive process only deals with the carrier.

In Kress and van Leeuwen (2006), conceptual structures represent participants into a further dimension, classificational. Classificational processes relate participants to each other; there is always a subordinate for a superordinate. However, classificational types were not found in the textbook's images and was not included in the analysis.

**Table 2.2 Representational visual structures adapted from Kress & van Leeuwen (2006).**

<b>REPRESENTATIONAL STRUCTURES (ideational)</b>	<b>Narrative Representatives</b>	<b>Processes</b>	Action (Actor + Goal) Reactional (Reactor + Phenomena) Speech & Mental Conversion Geometrical symbolism
		<b>Circumstances</b>	Setting Means Accompaniment
	<b>Conceptual Representations</b>	<b>Classificational Processes</b>	Covert Overt (Single or multi- leveled)
		<b>Analytical Processes</b>	Unstructured Structured 1. Temporal 2. Exclusive and inclusive 3. Conjoined & compounded exhaustive structures 4. Topographical and topological processes 5. Dimensional and quantitative topography 6. Spatio-temporal
		<b>Symbolic Processes</b>	Attributive Suggestive

#### 2.3.4 Interactive meaning

The discussion in the previous section has been centred around the ways that various kinds of visuals organise and represent their meanings representationally. I now turn to a discussion of the ways that visual images attempt to address their potential viewers in interactional terms in their visual grammar. Kress and van Leeuwen (2006) define the interactive metafunction as the interaction between the producer and the viewer of the image. Moreover, it provides an understanding of the power relations and attitudes that are constructed between the image and the viewer. In this interaction, Kress and van Leeuwen (2006) identify three kinds of relations:

- relations between represented participants
- relations between interactive and represented participants
- relations between interactive participants (the things interactive participants do to or for each other through images).

Kress and van Leeuwen (2006) suggest four ways to examine the social engagement between the viewers and the interactive meaning of images: contact (demand, offer), social distance (intimate, social, or impersonal), attitudes (involvement, detachment) and modality (real, not real) (see Table 2.2). Contact between the image and the viewer are concerned with the ways that images directly or indirectly address their viewers. The contact between participants can be established through the represented participants' gaze. In this sense, gaze explains the extent to which the viewers/readers are encouraged to engage with the participants.

Another level of interpretation of the interactive metafunction is the social distance. Kress and van Leeuwen (2006) describes this as the kinds of social relations between interactants, whether they be long-term or short-term relationships. Social distance is depicted in visual communication by different sizes of the frame. Attitudes refers to the degree of involvement or detachment between participants. Meaning is achieved by perspective which creates a meaning potential.

Another parameter that Kress and van Leeuwen also consider to be part the interactive metafunction is modality. Modality in this sense refers to the representation of people as though they were real or as though they did not actually exist. In the visual sense, modality

can be indicated by means of visual markers such as colour saturation, contextualisation, representation, depth, illumination, brightness and code orientation.

**Table 2.3 Interactive visual structures adapted from Kress & van Leeuwen (2006).**

<b>INTERACTIVE STRUCTURES (Interpersonal)</b>	<b>Contact</b>	<b>Image Act</b>	Offer; Demand
		<b>Gaze</b>	Direct; Indirect
	<b>Social distance</b>	<b>Size of frame</b>	Close; Medium; Long
	<b>Attitude</b>	<b>Subjective image</b>	Horizontal angle; Vertical angle
		<b>Objective image</b>	Action Orientation; Knowledge Orientation
	<b>Modality</b>	<b>Colour</b>	Colour saturation; Colour differentiation; Colour modulation
		<b>Contextualisation</b>	Absence of background; Full detail
		<b>Representation</b>	Maximum abstraction; Maximum representation
		<b>Depth</b>	Absence of depth; Maximally deep perspective
		<b>Illumination</b>	Full representation of light and shade; Absence of light and shade
		<b>Brightness</b>	Maximum brightness; Black and white or shades of light grey and dark grey
		<b>Coding Orientation</b>	Technological; Sensory ; Abstract; Naturalistic

### *2.3.5 Compositional meaning*

The compositional metafunction deals with the way in which the representational and the interactive metafunction come together into a meaningful significant whole. Meaning is built by three interrelated systems: information value, salience and framing. These systems are not restricted to single pictures, but they apply also to composite visuals.

Informational value is associated with the placement of elements in relation to each other. Kress and van Leeuwen (2006) show that the value of an element perceived by the viewer on the left side of the images maybe considered as old information, whereas those on the right side are to be decoded as new. Elements on top can be interpreted as ideal whilst the lower section focuses more on the factual and real. Salience refers to the method in which the elements in the composition are positioned to attract attention to various degrees (Jewitt & Oyana, 2001). For instance, a foregrounded image is more salient than one placed in the background. Salience can be determined by considering factors such as tone, size, contrast, colour, focus, perspective and overlap.

## **2.4 Situating the visual analysis into the terrain of cultural studies**

The highly-contested terrain of cultural studies has provided many researchers with both a theoretical and a methodological framework to understand visual representations in school textbooks not only as pedagogical tools but also as cultural objects. Indeed, the work of cultural theorists such as Stuart Hall (1997) has drawn attention to a view that depicts visual representation in the media and in textbooks as cultural productions, imbued with values, ideologies and beliefs of the culture which produce them. Hall (1997) also demonstrates that far from being singular and absolute conveyors of meanings, visual representations by their very nature are polymorphous and constitute a great diversity of meanings. In other words, images can have many different meanings and meaning-making is dependent on the viewer and the context of viewing. Thus, as Hall reminds us, visual representation cannot be reduced to one single interpretation and must be interrogated rather than accepted at face value.

Also of importance to the research context is Hall's assertion that visual imagery is produced within political and ideological climates that are raced and gendered, and where matters of power and social order are prominent. Such a view finds support from writers such as Longhurst et al (1999) who posit that "cultural studies treats representation [including visual

representations] as connected to the exercise and disposition of power, and can be linked to patterns of class, capitalism, gender and sexuality” (p. 270). Along the same lines, Hall (1997) emphasised the centrality of power relations in understanding visual representations by arguing that representation is always linked with power and that those groups who wield power in a society influence who gets represented through publications.

## **2.5 Language and science education**

The issue of the role of language in both learning science and in developing science literacy has been a long-standing concern for teachers, science researchers and policy-makers. Over the past three decades, there has been a significant body of research that has consistently highlighted the language of science as one of the major difficulties students have in learning science (Maskill, 1988; Osborne & Wellington, 2001; Swanson et al, 2014). Indeed, some scholars such as Jenny Henderson and Jerry Wellington have suggested that “the greatest barrier to learning science is the language barrier” (Henderson & Wellington, 1998, p. 35). Yet, lamentably, many science teachers still regard language to be “of marginal relevance to the learning of science” (Osborne & Wellington, 2001, p. 1). As a result, the role of language in improving the quality of teaching and learning has remained out of focus in the science classroom.

Likewise, in the Jamaican context, science researchers such as Soyibo (1996) have identified the complex language of science textbooks as the most significant hindrance to understanding scientific concepts. Although many factors are at work here, an important point of consideration is the glaring disparity between the students’ language of discourse, JC, and the language of science textbooks, Jamaican Standard English. In my view, if one accepts the notion of the symbiosis between science and language, then the case of bilingual and bidialectal societies must present particular difficulties, as students have to transpose concepts from one language/dialect to another. As previously indicated, many Jamaican students communicate using JC and this may pose significant difficulties in their ability to engage with the language of science textbooks in an effective and efficient way.

Against the background of the foregoing discussion, this chapter will examine some theoretical perspectives on the language of science textbooks and science education. In addition, it will include a discussion of the key issues concerning language and literacy in science education by synthesising a wide range of recent research by some of the leading



academics in this field. An examination of contemporary evidence and studies relating to the challenges faced by bilingual learners in comprehending the language of science textbooks will also be explored.

## **2.6 Theoretical perspectives**

The debate about the importance of language to the learning of science has been the focus of much attention by theorists and constructivist thinkers for many decades. As early as the 1970s, prominent writers such as Neil Postman and Charles Weingartner highlighted the critical relationship between language and knowledge in their 1971 book, *Teaching as a Subversive Activity*. They expressed the view that “almost all of what we customarily call ‘knowledge’ is language, which means that the key to understanding a subject is to understand its language” (p. 103). This perspective is further authenticated by Lemke (1990) who argues that learning any subject depends on learning the language in which the knowledge of that discipline is construed. In this respect, as Jay Lemke proposed in his widely influential book, *Talking Science: Language, Learning and Values* (1990), learning science involves learning to talk science. Lemke writes, “it means learning to communicate in the language of science and act as a member of the community of people who do so” (Lemke, 1990, p. 1). Previous studies have made it reasonably clear that to address students’ difficulties in learning the language of science, one must change the institutionalized commutative patterns which make science discourse seem futile and inaccessible (see, for example, Soyibo, 1995).

A discussion of the correlation between language and learning would be incomplete without a mention of the ground-breaking work of educational psychologist, Lev Vygotsky. Writing in his seminal 1978 book *Mind in Society: The development of higher psychology process*, Vygotsky argues that children learn about the world through interaction, in particular, that conversations become socialised into the child’s internal process. He viewed language as human’s greatest tool, a means of communicating with the outside world. For Vygotsky, children need to be able to talk about a new problem or a new concept to understand it and use it. Therefore, as the child discusses a problem or task with an adult, the adult supplies language to assist the child in solving the problem; the child gradually internalises the language until the task can be completed independently (Lantolf et al, 2014). This model of learning has been used broadly known as ‘sociocultural’ and have been used by science

educationalists to explain how meanings are developed through language and other semiotic means in the science classroom (see, for example, Mortimer & El-Hani, 2014; Mortimer et al, 2012; Roth, 2014; Scott, 1998; Tobin, 2012).

Central to Vygotsky's sociocultural approach is the notion of Zone of Proximal Development (ZPD), which supports a theory of assisted learning. In the Vygotskian view, the process of knowledge acquisition takes place in a social context or what he terms the ZPD. The Zone of Proximal Development is defined as "the distance between the actual developmental level, as determined by independent problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). A fundamental and integral part of Vygotsky's theory is the important role it gives to the teacher or some other knowledgeable figure, with whom meaning is developed through shared discourse. Thus, learning scientific knowledge is mediated by various semiotic resources, the most important of which is language. This notion of mediation of a shared discourse through language is one of the key tenets of Vygotsky's work and has been further developed by neo-Vygotskian scholars to explain the relationship between language and science learning.

Drawing explicitly on the ideas of Vygotsky's sociocultural views of learning, Clive Sutton offered an important theoretical perspective for analysing science classroom discourse in his 1996 paper, 'The scientific model as a form of speech'. The basic thesis which Sutton proposed is that science learning involves *learning to talk in new ways*, and he sees science lessons as opportunities to teach the language. Moreover, he argued that part of the job of the science teacher is to convince pupils of the value and rationality of those new ways. Sutton helps to popularise the new perspective that learning science should incorporate new ways of talking and thinking about the world. Within the ZPD, the Vygotskian notion has been drawn upon to explain the important role that language plays in mediating scientific thoughts between learner and teacher. Thus, according to Sutton, language is an essential tool for learning science.

Elsewhere, other science researchers have also adopted the Vygotskian perspective in developing an account of language science learning. For example, Joan Solomon (1994) suggested that the process of learning science was akin to a child's arrival on a foreign shore or struggling with a conversation in an unknown language" (p. 16). In her metaphorical account of how a child learns Solomon writes:

Imagine an alternative picture of pupil learning: – a young student sits outside a circle of disputing scholars picking up fragments of conversation and trying to piece them together. Once we were all that child, the family was the circle, and we turned over the phrases that we heard until they built up into an idea. We tried out the sense of it, and occasionally we were amusingly wrong. If we were lucky no one laughed. Then it was explained once more in helpful ways and with good games to go with the learning of it. When we tried it again and the half- formed idea seemed to be accepted by others, it became stronger. Kindly adults encouraged us to use it in new ways: our understanding and pride in using it grew. The idea gradually became ours and, by the same token, we became a part of the privileged and knowing circle who use it. (Solomon, 1994, pp. 17-18)

Solomon's description highlights the importance of language in discovering new ideas and making sense of scientific concepts. In this sense, learning is a process of enculturation in socially organised practices, through which specialised skills are developed by learners as they engage in conversation about science. Moreover, Brown, Collins and Duguid (1989) argue that *to learn to use* tools as "practitioners use them, a student, like an apprentice, must enter that community and its culture" (p. 33). Consistent with this view point, Lave and Wenger (1991) suggested that learners are seen as "participating in communities of practitioners and that mastery of knowledge and skills requires newcomers to move towards full participation in the sociocultural practices of communities" (p. 29). The ideas advanced by Sutton and Solomon are central to the sociocultural theory championed by Lev Vygotsky and highlight the important role that language plays in science classroom discourse.

According to Fang (2006), the language used to construct knowledge, beliefs and worldviews in school science is distinct from the social language that the students used in their everyday ordinary life. This difference presents a major obstacle for students when learning the language of science. Thus, a significant challenge for science teachers is to help students move from everyday informal ways of construing knowledge into the technical and academic ways that are necessary for learning the language of science. As Schleppegrell (2007) argues, "each subject area has its own ways of using language to construct knowledge, and students need to be able to use language effectively to participate in those ways of knowing" (p. 140).

Over the last two decades, considerable research energies have been devoted to explaining the linguistic challenges in science education. For example, in the United States, Swanson et al (2014) examined how an urban high school science teacher engaged her English Language Learners in the discourse-intensive science and engineering practices of (1) arguing from evidence and (2) obtaining, evaluating, and communicating information. They concluded that the students encountered significant difficulties in participating in classes, crafting arguments from evidence and reading the technical vocabulary of the texts. The researchers contended that the outcomes emphasise the need for more attention to be placed on the teaching and learning of discourse in science. A similar picture emerged from a study conducted by Miller (2009) on a group of years 8 science refugee students in a high school in Australia. The research highlighted the difficulties the students encountered in grasping scientific concepts because of their poor linguistic understanding. Furthermore, technical vocabulary, dense noun phrases and the over use of conjunctions were also emphasised as major barriers to learning.

In addition, a subsequent case study in Australia, led by Seah et al (2014), examined the language demands on students from an Integrated Science and language perspective.<sup>13</sup> The researchers identified the language demands by comparing the students' writing with the scientific account of expansion that the teacher intended for them to learn. They found significant differences between the students' writings and the scientific account. The investigators reflected on the need for further research to understand the demands of learning science through language.

## **2.7 Gender in science textbooks**

That gender significantly affects students' abilities to comprehend science textbooks is disputable. However, gender should be a consideration in a study of this nature since the role of women in Jamaica differs from that in many developed nations. Jamaica is still for the most part a conservative country and the traditional roles of men and women still exist (Whitely, 1996). Thus, despite radical transformation in gender equality in some aspects of the workforce in Jamaica, there is anxiety about the dearth of women in other fields, such as science, engineering, construction and technology, when compared with first world countries

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<sup>13</sup> Case study focussed on the topic 'Thermal Expansion'.

(Elliot, 2013; Panday, 2014; Stromquist, 2013). Some scholars such as Watts (2013) have traced the problem back to secondary schooling where choices in studies and play are still often made along gendered lines. Consequently, this has affected attitudes towards the value of education for girls, especially in science. Various studies (e.g. Phipps, 2008; Watts, 2013; Whitely, 1994) in a range of countries have shown that in the general population there is a difference between boys' and girls' perception of science as a worthwhile activity and marked differences in their reading habits.

During the last two decades, a growing body of research has attempted to explain the differential success of women and men in science education (Keller & Dauenheimer, 2003; Phipps, 2008; Turner & Bowen, 1999; Watts, 2013). These studies have demonstrated a distinct gender gap in the post-compulsory participation of male and female students in science. Moreover, a relative mere handful of women choose to enter careers that have been traditionally viewed as men's work; women are still underrepresented in the natural sciences and engineering work force in the United States (U.S. Department of Labor, 2002). The same is true for developing countries, like Jamaica (Bailey, 2004). Notably, this gap does not emerge until the latter years of high school (Bazler & Simonis, 1991), which has led many prominent academics to conclude that these differences in preferences between male and female students are not caused by biological factors but instead are learned through socialisation (e.g. Bleeker & Jacobs, 2004). It has been well established that children learn role expectations through various forms of media, including textbooks (Brownlow & Durham, 1997). This leads me to pose the following question: Could science textbooks be a contributory factor in the difference between male and female students in their post-compulsory participation and achievement in science?

Concerns about girls' underachievement in, and lack of uptake of, science courses have been the subject of much intense debate by leading academics in science education for the last three decades and research findings emanating from a range of countries demonstrate that equity in science education is still a cause for concern. Writing from the United States, Tolley (2014) observed that there continues to be significant gender differences in science experiences, attitudes and perceptions of science courses and careers. Her research findings further revealed that significantly more females than males reported that science was difficult to understand and was more 'suitable' for boys.

In a similar study in Australia, Dawson (2000) investigated whether the overall levels of interest in science of upper primary boys and girls detected in 1980 had changed in 1997. Her finding revealed that while overall students' interests had changed little, the gap between boys' and girls' interest in the physical sciences had in fact widened, with boys' interest in the area being far greater than girls'. In light of these findings, Dawson emphasised the need for gender equity in science education and highlighted the role of the teacher in presenting science as equally appropriate for girls and boys. In adding to the foregoing discussion, Elgar (2004) noted that since one of the teacher's primary resources is the textbook, teachers would find it easier to present a science free from gender bias if textbooks themselves were gender fair.

Many studies of gender portrayal in science textbooks indicate that science texts support the stereotype of the natural sciences as predominantly masculine in nature. Potter and Rosser (1992) conducted the most comprehensive study of those found. They examined five widely used seventh grade life science textbooks for sexist language, images and curricular content. The findings revealed the following patterns in the text illustrations: (1) all five books pictured more male than female scientists; (2) three of the books pictured no female scientists; and (3) males were portrayed in a broad range of activities with a focus on 'doing', while female figures tend to 'pose', engaged in passive behaviour or playing more limited roles. They found no evidence of direct sexist language but a relatively low level of integration of achievements of women scientists. The authors are of the view that "to attract larger numbers of women to science, consideration of the extent to which a textbook presents material and activities that effectively interest, prepare, and encourage females must become a significant factor in that choice" (Potter & Rosser, 1992, p. 684).

In another study in the US, Bazler and Simonis (1991) compared two generations of seven high school chemistry textbooks (1970/1973 and the most recent editions) and analysed them for gender fairness in illustrations and in concrete analogies. The research findings indicated an overall improvement in the ratio of female to male images in most of the textbooks examined, but only one achieved gender parity. The authors express their concerns that the underrepresentation of images of science involving women may result in pupil viewing science as an activity that excludes female students (Bazler & Simonis, 1991, p. 354).

## 2.8 Translanguaging and bilingualism

In the past two or three decades, conceptualisation of bilingualism has been focussed on the idea “that speakers draw on linguistic resources which are organised in ways to make sense under specific conditions” (Heller, 2007, p. 1). This perspective challenges the traditional conception of language by structuralist writers such as J. R. Firth (1968) who advanced the idea that language as a ‘system’ existed apart from the speaker and social life. Indeed, this more recent understanding of how language operates places the speaker at the heart of the interaction” (Blackledge & Creese, 2010, p. 109) and operates with the assumption that languages, rather than being static and bounded structures, are fluid, dynamic and constantly evolving with no geographical boundaries (Makoni & Pennycook, 2007). Also, concomitant in this critical shift in ideology is a move that positions language as “a verb and an ongoing process” rather than “a noun or something that has been accomplished” (Wei, 2011, p. 1223). Such ideological positioning has also led to a shift in terminology from the noun ‘language’ to the verb ‘linguaging’ (Garcia & Wei, 2014). The term ‘linguaging’ has been used by many sociolinguists (see, for example, Becker, 1988; Canagarajah, 2007; Makoni & Pennycook, 2007) to capture diverse meaning-making within and across languages. Such a view is supported by writers such as Garcia and Wei (2014) who argue that the adoption and use of the term linguaging “is a better way term to capture an ongoing process that is always being created as we interact with the world lingually” (p. 8).

More recently, writers such as Lewis et al (2012), Blackledge and Creese (2010) and Garcia (2009) have expanded the idea of ‘linguaging’ to include the now increasingly used term in linguistic scholarship ‘translanguaging’. According to Baker (2011) “translanguaging is the process of making meaning, shaping experiences, gaining understanding and knowledge through the use of two languages” (p. 288). Garcia (2009) argues that translanguaging extends beyond the notion of ‘additive bilingualism’ and represents a new language practice. For Garcia (2009), translanguaging is “an approach to bilingualism that is centred not on languages ... but on the practices of bilinguals that are readily observable” (p. 44). In this bilingual environment, “both languages are used in a dynamic and functionally integrated manner to organise and mediate mental processes” (Lewis et al, 2012, p. 1).

The notion of translanguaging is similar in many respects to code-switching in the sense that it refers to bilingual or multilingual speakers shuttling between language varieties at various

level including “phonological, grammatical, lexical [and] orthographical” (Skiba, 1997, p. 1). Moreover, code-switching assumes that bilingualism contain two languages that are structurally separate (Garcia, 2009). Translanguaging, however, widens the parameters of code-switching to include a heteroglossic view of the linguistic behaviour of bilingualism in which both languages operate as “as one integrated linguistic system” (Garcia & Lin, 2016, p. 4). In this pedagogical practise, bilingual learners use all their linguistics repertoire in meaning making and gaining a deeper understanding of curriculum content (Baker, 2011; Garcia, 2009).

## **2.9 The theory of hegemony**

In the above discussion, I have argued that language in Jamaica operates in conditions of unequal relations. I have also shown how the education system is used by dominant groups to legitimize these unequal relations. The concept of hegemony offers a conceptual framework to explain how this language ideology is maintained and reproduced through the manufacturing of mass consent. In this section, I discuss the notion of hegemony. I take as a point of departure Gramsci’s and Scott’s conceptualization of hegemony. My focus on the way in which these two scholars have theorized hegemony within the context of language ideologies does not mean that the contribution of other scholars within this discursive domain is not relevant and instructive to contemplate. However, I consider Gramsci’s and Scott’s conceptualizations to be the most significant to understanding how a general pattern of power imbalance and exploitation is given a unique shape through the cultural encounter between JSE and JC. It is important to point out here that language cannot be considered an integral part of either Gramsci’s or Scott’s articulation of hegemony. Nevertheless, it has been used extensively to explain the intersections between the social production of knowledge and the perpetuation of inequitable power relations. Thus, I consider it an indispensable concept for any understanding of the social power relationships between majority and minority languages.

The term hegemony is derived from the Greek *egemonia*, meaning leadership or rule, but perhaps is best understood as the preponderant influence or political predominance of one state over another in international settings. For many social theorists, especially those operating within a broadly post-Marxist paradigm, this seems a useful definition. The arguments, which can be fierce, are not new, and are pertinent in understanding the



structuring of social relations by bringing into focus the process by which a dominant class articulates the interests of social groups such that those groups actively 'consent' to their subordinated status. However, the concept of hegemony has been applied more broadly to the analysis of social phenomena across a wide comparative range of contemporary societies rather than state to state. These approaches have been expanded and refined to make them more applicable to contemporary social and power relations in the 20th century. In this sense, the notion of hegemony is an extremely flexible theoretical tool to explain how our consent to networks of power is produced within contemporary capitalist societies.

The theorist most closely associated with the concept of hegemony is Antonio Gramsci. Gramsci's theorization of hegemony is scattered throughout his fragmentary body of essays and polemical writings and, as Stuart Hall indicates, constitutes the most significant contribution to 20th-century Marxist thoughts (Hall, 2006). Taking his cue from the tradition of Marxist scholarship defined by the work of Marx and Engels, he theorized not only the necessary conditions for a successful overthrow of the bourgeoisie by the proletariat, but also the structure of bourgeois power. Gramsci's conceptualization of hegemony refers to the process of establishing dominance within a culture not by brute force, but by voluntary consent, by leadership rather than by rule. During his later writings, encompassed in the *Prison Notebooks*, he went on to expand the concept of hegemony even further by suggesting that the maintenance of that consent is dependent upon an incessant repositioning of the relationship between rulers and ruled (Hall, 2006). Thus, the dominant class must be sufficiently flexible to respond to new circumstances and to the changing wishes of those it rules: precisely because it is a process, it cannot be secured once and for all. Instead, it is responsive even at those moments when a ruling class can no longer generate consent. It should be noted that, although Gramsci's hegemonic concept operates broadly in a Marxist terrain, and in this sense, is epochal, it remains of seminal importance to explain complex social phenomena in the modern world.

Equally important in relation to Gramsci's conceptualization of power/hegemony is the role of the intellectuals and their relationship to the state and social change. His categorization of intellectuals encompassed not just academics and scholars, which he describes as 'organizers of culture', but went much further to include a broad group of social agents or functionaries, who exercise technical or directive capacities in society. Among these are politicians, civil

servants, teachers, and doctors. Essentially, Gramsci saw the role of the functionaries or the already mentioned organizers of culture as responsible for the formulation and spread of the organic ideologies of a hegemonic class. Indeed, Gramsci's notebooks are quite clear on this matter. He criticized intellectuals as potential 'deputies' or functionaries of the hegemon, "exercising the subaltern functions of social hegemony and political government" (Gramsci, 1971, p. 246).

Stuart Hall, through his reconceptualization of Gramsci's work, suggested that it is possible for intellectuals to be tricked into alliance with hegemonic rule by showing support for policies which enjoy a high regard among the wider community and in which the intellectuals themselves also share abiding interest, due to what Gramsci called their 'organic' and/or 'traditional' associations with the ruling classes in the society. These policies are used by the hegemon to put into effect an ideology which maintains and stabilizes the leadership of that hegemon and allows for the production of other controls. As previously mentioned, Gramsci's expressed ideas did not specifically address the problems of indigenous language in the society; however, his concepts are of profound importance in thinking about the ideological articulation of language issues within the education system and serves as a useful point of departure in this chapter.

A further controversial position on hegemony is provided by James Scott in his book, *Weapons of the Weak: Everyday Forms of Resistance* (1985). In his most influential argument, Scott theorizes hegemony in relation to resistance practice by bringing into focus the process by which subordinated groups counter hegemonic ideologies through the nuances of daily life. More specifically, Scott's articulation maintains that in situations of relative safety, subordinates display an impressive capacity "to understand the larger realities of capital accumulation, proletarianization and marginalization" (Scott, 1985, p. 30). They avoid overt and open defiance against external domination, though they are aware of their inferior position in the social hierarchy. Instead, they participate in subtle, less visible, and indirect strategies of opposition, such as procrastination, circumvention, false compliance, feigned ignorance, defamation, and sabotage. These forms of resistance against the institutional authority required little or no coordination or planning.

Far from seeing subordinated groups as passive subjects complicit in their own subjugation, Scott expands Gramsci's conceptualization of hegemony by arguing that subordinated

individuals possess a measure of agency to engage in resistance. The vehicle of this agency, its 'cement' so to speak, is language, which is conceived of as a form of discursive practice in which dominated groups engage in everyday forms of resistance that allow them to reshape the social context in which they are embedded. Indeed, some scholars of language ideology have sided with the view that the emergence of the JC might be construed as one of the ways in which proletariats grasp agency and counter the effects of hegemony (Woolard & Schiefflin, 1994). For not only did the JC allow for social interactions to take place in communities and cause the breaking down of their linguistic isolation, but the developing of JC also allowed for the crystallization of a burgeoning cultural identity. In this sense, Scott moves the narrative beyond simple binary oppositions that are still habitually used: dominant versus subordinate; empowered versus those separated from power, to a more nuanced understanding of the dialectical processes and actualities between hegemony and resistance in shifting social landscapes.

Scott's notion of hegemony has been influential within the anthropological study of resistance, insofar as it shifts attention from organized rebellions or collective action to the more pervasive, less institutionalized everyday forms of resistance which subordinated people operate through symbolic sanctions. Nonetheless, critics of Scott's exegesis have pointed to several limitations in relation to his interpretation of everyday forms of resistance and the extent to which it is generalizable in the wider historical, socioeconomic, and political contexts. For instance, Michael Brown (1996) described it as a 'theoretical hegemony' with limited utility. A similar argument, made by Sherry Ortner (1995), criticized Scott for not devoting analytical attention to "the ambiguity of resistance and the subjective ambivalence of the acts for those who engage in them" (p. 177). Ambivalence, she argues, may arise from divided interests or as the results of moral constraints, and may under certain circumstances produce political paralysis. Ortner calls for a thicker ethnographic exploration of the internal politics, conflict, and power hierarchies that exist within subordinated groups.

Despite the major debates surrounding the concept, hegemony remains a productive philosophical framework for highlighting power relations between dominant and minority groups. Moreover, it has been a focal point of postcolonial and cultural studies, and has generated theoretically complex and rich formulations relating to human opposition to various forms of power and to resistance in a myriad of differing social contexts, including the

social relationships between majority and minority languages. Many cultural and social reproductionists (Amador, 2016; Rosen, 1980) have shown how hegemony is established by means of language, specifically with the imposition of the lingua franca of the hegemon and it is to the discussion of these issues that I now turn.

### *2.9.1 Linguistics hegemony in science education*

The argument I have adduced so far has shown how the notion of hegemony can help us to understand how a dominant class exerts power over social institutions and, thus, strongly influences the everyday narratives, discourse, and behaviour of the rest of society by directing the normative ideas, social representations, values, perceptions, and belief systems which become the dominant worldview of a society. Furthermore, we have also seen how hegemonic thoughts are used by organizers of culture, in a Gramscian sense, to stabilize a form of power and domination which is then used to keep the masses of the people in their subordinated place in the social formation. In this section, I attempt to extend the parameters of these hegemonic arguments to include the social power relationships between JSE and JC in science education, and to draw attention to how JSE operates as a convenient set of tools for the preservation of linguistic hegemonic ideology in classroom discourse.

The concept of linguistic hegemony is perhaps one of the most generative concepts in the sociolinguistics literature and a useful framework in understanding how dominant groups operate by convincing others to accept their language norms and usage as standard, even though this may not necessarily be in their own interests. Conceptually, linguistic hegemony can be understood as occurring in situations where more than one language or language variety exist together but their status in relation to one another is asymmetric. In such a formulation, “linguistic minorities will believe and participate in the subjugation of the minority language to the dominant, to the point where just the dominant language remains” (Suarez, 2002, p. 514). Thus, linguistic hegemony is maintained through an unequal power relationship between dominant and minority languages. In this sense, linguistic hegemony exerts and legitimizes power by presenting the dominant language or variety of a language, such as JSE, as an instrument or tool to be used by those who acquire it in whatever way they choose.

The above perspectives have been used to situate and position English language as a dangerous hegemonic force that serves to reinforce unequal divisions of power based on

English proficiency. For many, English and the command of it has been constructed as a powerful tool for development and advancement in a globalized world. Thus, it would seem that proficiency in English has become something of a commodity, valuable both because of its utility, described by former Jamaican prime minister, Edward Seaga, as one of our competitive advantages in terms of communication and economic development, as well as for its image as a form of cultural capital (Hill, 2011). Such ideology has given the English language an unparalleled status as the indisputable language of power, free of the limitations that the ambitious attribute to their native languages. However, while some observers point to the above observations as positive developments for humanity, others have highlighted the dangers of promoting English language in this way, to the exclusion of all other languages. Indeed, much of the recent attention to the spread of English deals precisely with this point: that “the dominance of English is asserted and maintained by the establishment and continuous reconstitution of structural and cultural inequalities between English and other languages” (Phillipson, 1992, p. 47).

In Jamaica, there seem to be a standard objection to the use of JC in science communication. The implicit rubrics that underpin this opposition are predicated upon negative attitudes towards JC. As Dennis Craig (1999) notes, “The chief reason why the Creole or Creole-influenced language of West Indian people has not been used in education lies in deep-seated community attitudes to Creole” (p. 101). The official attitude of ignoring its existence or advocating its eradication has already been mentioned. In the community at large, JC has generally been identified historically with slavery and in more recent times, with low social status and lack of education. These prejudices have been used by the English-speaking elites who control the national journals and the more prestigious publishing houses to apply great pressures on science researchers to publish in JSE, even though such communications are highly relevant to national needs and aimed largely at Creole speakers. That is not to say there is not a genuine belief amongst academics that writing in JSE will have a wider audience and thus, will advance their own career.

Some advocates representing the hegemonic class have consistently highlighted the positive impact that English dominance has had on science education. In such cases, the central argument advanced is that a global academic environment needs a common medium of communication, and thus English, the most widely distributed, is the only possible language.

Furthermore, English as an international language provides greater opportunities for scholars to disseminate their academic achievement to a wider audience. This argument is relevant and reasonable to make. However, there is a danger that such arguments perpetuate the myth that non-standard languages, including JC, are inadequate for representation of science knowledge. Moreover, there remains the further problem that such views are rapidly becoming at odds with the linguistics landscapes and the increasingly multilingual nature of many communities. The importance of discourse in science education has been given specific attention by researchers such as Courtney Cazden (2001). Through discourse, students can bring a critical stance towards ideas based on reasoning and learn to engage in arguments and explanations. Moreover, through discourse, students gain understanding of the nature of science and technology and the ways in which it is changing, making sense of ideas, and communicating these ideas to other people.

#### **3.1 Introduction**

The aim of this chapter is to situate the study, into the extent to which Jamaican students can access the language demands of science instructions, within a critical, multi-perspectival, and multi-method approach to inquiry. Further, I outline a rationale for the 'multi-perspectival' methodological framework adopted in the study and argue that such an approach enables researchers to embrace the combined strengths of different epistemological and theoretical positions, albeit sometimes such perspectives are incommensurable. Additionally, I present a detailed description of the sample, quantitative, and qualitative measures that will be utilised and conclude with a brief description of the ethical guidelines which were adopted for the data collection.

A research agenda will be developed in response to the research question linked with the conceptual and theoretical framework; supported by a justifiable range of analytic techniques. The development of a research agenda will lead to the selection of an appropriate methodology which will also be discussed in this chapter. I will demonstrate how the research design, epistemology, method and data analysis will enable me to produce a robust and credible investigation into the accessibility of science textbooks to Jamaican students.

#### **3.2 Rationale for multi-perspectival approach**

As discussed above, the approach underpinning this study is both multi-perspectival and multi-method (Best & Kellner, 1997; Borradori, 2003; Monceri, 2003; O'Regan, 2006) which will influence the collection, analysis, and interpretation of the data. The notion of a multi-perspectival study as promoted by Kellner (1995), involves the collection and triangulation of data generated from a selection of primary and secondary discursive practices, including text and other semiotic forms. In discussing the implications of this approach, the authors Jorgensen et al (2002) argue "that a combination of different theories and methods is well suited for critical research as different perspectives demonstrate that the social world can be understood and constructed in various ways" (p. 155). Thus, bringing several different

methods into dialogue with one another will provide a multidimensional approach to the study that can attend to the complexity of social phenomena.

Moreover, advocates, such as Kellner (1999), argue that “the more perspectives one can bring to their analysis and critique, the better grasp of the phenomena one will have and the better one will be at developing alternative readings and oppositional practices” (p. xii). Hence, using a multi-perspectival approach in this study will reduce the impact of bias, assumptions, and limitations brought to the research process by allowing me to examine the accessibility of science instructions in greater dimensions than if I employ a single-method approach. Furthermore, such an approach can improve the accuracy of the results by collecting and analysing different types of data. Although some researchers argue for the flexible use of one method within a multi-perspectival framework (see Frost, 2011), this study will employ a multi-method approach to enhance dimensional insight and illuminate the complexity of the phenomena under study.

### **3.3 Textbook sampled**

The textbook that is analysed in this study is Mitchelmore, J. (2009) *Investigating Science for Jamaica*, Book 3 (UK: Nelson Thornes). This textbook was selected as a preliminary survey I conducted indicated that it is among the most widely used in the lower forms in Jamaican secondary schools. It was written and edited by a review panel consisting of education officers and teachers who took considerable efforts to use language, materials, and examples that are suitable and appropriate for the local context. The textbooks contain just under 200 pages and is copiously illustrated with full-colour photographs, line drawings, tables and diagrams.

### **3.4 The research agenda**

The research question examines the extent to which secondary school science instructions in Jamaica are accessible to their intended audience. One of the main aims of this study is to see whether science students have difficulties when learning the language of science in textbooks. As reviewed above, many studies have shown that the language used in some science textbooks exceeds the normal experience of many high school students for whom they are written (see, for example, Fang, 2006; Miller, 2009). Moreover, Curtis and Millar (1988) argue that if the understanding of textbook language is difficult for English speakers it is likely to be even more difficult for students in a second language. Scholars such as Osborne



and Wellington (2001) have consistently argued that it is the language which is the main barrier for learning science rather than the science content itself. Therefore, given the importance and continuing predominance of textbooks in the science curriculum, possible comprehension challenges that the language of science textbooks may present to students warrant investigation.

As I have argued in Chapter 2, school science textbooks are also vehicles through which attempts are made to disseminate and reinforce dominant cultural values. Apple (2004) in reflecting upon the USA, reminds us that school textbooks not only transmit curriculum content but values and beliefs of those in power. In this sense, they present the reader with cultural messages and introduce them to an existing cultural and socio-economic order with its relations of power and domination. Thus, this study is also interested in exploring the ways in which people and groups are represented in the science textbook under investigation. This I believe will provide a more holistic approach to the investigation of science textbooks and provides an important context from within which to investigate the interplay of power and culture.

The framework for language analysis, identified in the review of literature, is based on Halliday's SFL analysis. Halliday (1978) identified three key areas for language analysis that must be considered: the 'field' or institutional setting; the 'tenor' or relationship between participants; and the 'mode' or channel of communication. Consequently, the accessibility of the textbooks to Jamaican science students will be examined from three viewpoints: as a contributory factor to students' performance on tasks (field); as a judgment by students and teachers (tenor); and as a property of the textbook (mode). All three components of Halliday's context of situation are essential to describe sufficiently the accessibility of the text from a language perspective (Halliday, 1978). However, the study extends Halliday's meaning of what is the mode to focus on other social and cultural resources for making meaning in a specific context (Kress, 2010). Simply put, to include modes encompassed by multimodality.

With respect to the students' performance on the tasks related to the science textbooks three research tools were considered: comprehension test; Cloze test; and examination analysis. Many research studies have established a comprehension test as a valid and reliable instrument for assessing accessibility of school textbooks (Agnihotri & Khanna, 1991; Spooner et al, 2004). According to Agnihotri and Khanna (1991), students' scores on a text

comprehension task showed significant correlations with the Cloze test scores for a range of texts. However, some authors, such as Gellert and Elbro (2013), have argued that these tests may not identify comprehension, but only assess the surface level of word and sentence processing. Moreover, a comprehension test gives scant attention to the interpretative aspect of reading and understanding (Kearsey, 1997). A comprehension test was consequently rejected as a research tool. Similarly, although examination analyses are unobtrusive and time efficient they were also rejected as impractical since examinations do not emulate the classroom context.

A Cloze test was adopted for use in this study because it has been extensively used as a language proficiency testing tool and has been found to be efficient, reliable, and valid (Schmitt & Sha, 2009; Sharp, 2009). Although its validity as a measure of reading comprehension has been questioned by several writers (see, for example, Carlisle & Rice, 2004; Farr & Carey, 1986; Pearson & Hamm, 2005) the Cloze test has gained popularity as a second language testing device capable of assessing students' language proficiency in a practical and efficient way. Gellert and Elbro (2013) argue that "Cloze tests are not inherently limited to "local" comprehension, rather, Cloze tests are natural tests of inferences, and the inferences are not necessarily limited in scope" (p. 17). Moreover, according to Nellist and Nicholls (1986), Cloze tests can also indicate difficulties with vocabulary and have been used to validate scores from readability formulae. The procedure and data analysis for the Cloze test are presented in Chapter 4.

Another focus of the present work is to examine the accessibility of the science instructions as judged by students and teachers. This could be studied by either the use of observations, questionnaires or interviews. Observation as a research tool has been used in a variety of disciplines for collecting data in qualitative research. Observations can provide a depth and breadth of information to research that is difficult to obtain with other data-collection methods. The approach can be flexible and allow an observer to get inside a situation in a manner that can reveal information not readily obtained by other methods. This approach is particularly useful for providing the researcher with ways to check for nonverbal expression of feelings. However, observation was rejected as research tool because an awareness of the participants being observed may affect participants' behaviour. Furthermore, it would be extremely difficult to organise observations of Jamaican science teachers as I am no longer

living in Jamaica and it would prove to be an expensive process. However, I was granted permission by three teachers to observe their science lessons (these lessons were in two junior high schools and one upgraded high school). These observations were somewhat ad hoc and are not an important tool of my data collection.

Interviews have been widely used in educational research and have provided researchers with an incomparably rich source of data. Proponents of interviews as a method of data collection point out that they are highly purposeful tasks which go beyond mere conversations. Interviewing gives the interviewer the opportunity for in-depth probing and allows the researcher to pick up non-verbal cues, including facial expressions and tones of voice. However, the use of interviews was discounted as a main method of data collection for this part of the study since interviews are time consuming. However, a sub-sample of the students and teachers were selected for interviews. Description and data analysis of the interviews are presented in Chapter 7.

In the research methods literature, questionnaires are typically seen as reflecting a 'positivistic' research orientation and are usually viewed as an objective research tool that can produce generalizable results. Although questionnaires are a less direct means of data collection than interviews they are less time consuming and can be administered without the presence of the researcher with limited effect on its validity and reliability. In addition, data from questionnaires can be quickly and easily analysed either manually or using a software package. For the reasons outlined above, this study will employ questionnaire as the main research tool in addressing the question of the accessibility of the science textbooks as judged by students and teachers. These data for the questionnaire analysis are presented in Chapter 6.

Studied from the third perspective, as a property of the textbook (mode), two research methods were contemplated: lexical density analysis; and readability formula analysis. Lexical density is the term most often used for describing the proportion of content words (nouns, verbs, adjectives and some adverbs) relative to the total number of words. According to Johansson (2008), "a text with a high proportion of content words contains more information than a text with a high proportion of function words (prepositions, interjections, pronouns, and conjunctions)" (p. 66). Moreover, the lexical density of a text is also an indicator of sentence structure since it involves the use of closed-class words such as prepositions,

determiners and pronouns. Research evidence indicates that scientific texts are more likely to have a very high lexical density and hence provide a major source of reading difficulty for many students (Fang, 2006; Halliday & Martin, 2003). Lexical density analysis has been used successfully in many studies for considering the readability of a text and could be a useful tool for this research. However, lexical density analysis was rejected as a research tool because it provides similar statistical data as a readability formula. The latter was adopted as the results are easier to interpret.

Readability formulae are tools used for predicting the readability of a text by calculating reading levels from statistical features of text, such as the number of words per sentence and length of words. Despite being efficient and user-friendly, the formulae have been criticized on the grounds that they are not sensitive to modification in the factors they are based on. Moreover, they fail to consider other factors which play roles in the comprehension of written materials. In adding to the criticism of readability formulae, Dausgs and Dausgs (1974) commented that they ignore the uniqueness of the vocabulary of science. However, Perera (1980) acknowledges the value of readability formulae as tools in research, as long as their limitations are recognised. Although readability is not a focal point of this study, it is necessary to consider how close the reading level of the text is to the reading level of the reader. A readability formula, Fry Graph Readability Formula (1968), was chosen for this purpose on the basis that it is well established, “easy to apply, has reasonable validity, and over the years has proved to be quite accurate” (Wellington & Osborne, 2001, p. 142).

### **3.5 Outline of the sample and time line for the collection and analysis of data**

Data collection began in Jamaica during the second week of November 2015. The sample was determined by using a purposive sampling approach (Patton, 1990) and was drawn from a pool of 450 Year 7 students and 54 teachers from the five school types discussed in section 6.3. The schools were selected because they had a large cohort of Year 7 students and I have an excellent working relationship with the head teachers and most of the teachers in the science departments. In addition, a sub sample of students and teachers from each of the five school types were selected for interviews. Interviews were of two types, group interviews with the students (each group consisting of six participants) and individual interviews with the teachers (a total of 18).

A Cloze test was used to investigate the students' performance on the tasks related to the science textbooks (see Appendix D for Cloze test task). The test was administered to all the year 7 students (N = 450) during the second week of November 2015. This time line was chosen to limit the students' prior exposure to the passages selected for the test. The test instruction was read to the participants and they were informed that the test results will only be used for the purposes of this study and will not form part of their science assessment. The participants were then asked to record their responses directly in the spaces on each test. One of my research volunteers was present in the room during every testing session to ensure that each participant worked individually on his or her own and that there were no external distractions. The test was administered at a rate of three passages per test period, the test period being 50 minutes. Further details of the Cloze test are provided in Chapter 7.

Each of the students who took part in the Cloze test also completed a questionnaire. The aim of the questionnaire was to examine the accessibility of science instructions as judged by the students (see Appendix C). My initial plan was to administer the questionnaires at the same time as the Cloze task. However, I wanted to cause as little disruption as possible to the participants' lessons and administering both would take up too much time. Consequently, the questionnaires were given to the participants during my visit to Jamaica in June 2016. My visit to the schools caused little disruption to the school's curriculum as students were off timetable during the final week of the summer term. To increase the response rate and assure the quality of response, I administered the questionnaire while the participants were in their form rooms. Analysis began early in the study (June 2016) so that there was an iterative process in which data collection informs and is informed by developing analysis.

The interviews of science teachers and science students also took place during my visit to Jamaica in June 2016. The interviews were semi-structured and directed by an interview guide that was formulated from the research questions. Interviews were digitally recorded and transcribed in full. An inductive analysis was used to look for themes and commonalities as they emerged from the data. The themes were then extracted from the original categories and placed in individual files using a process of open coding. Analysis of the interviews started in the summer of 2016. Some of the early findings were fed back to the teachers, so that opportunities for reflection and contemplation can be generated. Researchers such as Davies (2003) have stressed the importance of feedback and dialogue over time between researcher

and participants to explore possibilities for changing perspectives and increasing reflexive awareness. Further details of the students' and teachers' interviews are provided in Chapter 7. Additionally, sample transcripts of both the students' and teachers' interview are presented as Appendix A and B, respectively.

### **3.6 Procedural issues**

Several verification procedures as identified by Lincoln and Guba (1985), Merriam (1988), Stake, (1995) and Yin (1994) were a feature of this study: triangulation, member checking, and detailed records of data collection and analysis procedures.

The trustworthiness of the data sources was strengthened by using Patton's four kinds of analysis (1990). These were:

1. Checking the consistency of findings generated by different data-collection methods – that is (a) methods triangulation
2. Checking the consistency of different data sources within the same method – that is (b) triangulation of sources
3. Using multiple analysts to review findings – that is (c) analyst triangulation
4. Using multiple perspectives or theories to interpret the data – that is (d) theory/perspective triangulation.

### **3.7 Ethics**

There are several ethical considerations relating to research with students and teachers, which relate to recruitment, informed consent, anonymity and confidentiality. All research was conducted in line with the British Education Research Association (BERA) guidelines, the policies of UCL Institute of Education and with the support of the Faculty Research Ethics Committee. Initial contact was made with the Head Teacher and the Head of the Science Department through an informal conversation and if they were interested in participating, they were sent a letter and an information leaflet outlining the nature and purpose of the research. As argued by Burns (2000) "participants must understand the nature and purpose of the research" (p. 188). The approach discussed above balances informality with the provision of clear information and ensures informed choices and has proven to be successful in recruiting young people in a range of different contexts (Devries et al, 2013; Pyrini, 2013).

An important ethical consideration was considered is the issue of consent of the participants. As outlined by the BERA (2011) and supported by authors such as Cox et al (2014), when working with vulnerable people, such as children, several steps must be taken to ensure that they are protected. This included contacting the parents of the children via a letter, requesting written consent for their participation (BERA, 2011). Furthermore, as suggested by Aluwihare-Samaranayake (2012) and in line with the BERA guidelines, I explained the research process to the participants, including the benefits of the research to their school but outlining clearly that if they did not wish to participate they could leave at any time (BERA, 2011; Clause 15). An opt-in strategy was adopted for recruiting participants.

Other key issues considered as highlighted by Corbin and Strauss (2014) are protecting the anonymity and confidentiality of participants. To this end, all the participants were given a code instead of using their names. Moreover, in the data analysis no mention was made regarding personal traits of participants to protect their identity. Considerable effort was made to sustain confidentiality of the participants. In this regard, all participants' personal details and the audio-recordings from the interviews were kept on a password-protected computer while the completed consent forms, test papers, questionnaires were stored in a secure locker, ensuring in this way that the records and data were secured (DePoy & Gitlin, 2015).

## CHAPTER 4

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### ANALYSIS OF THE CLOZE TEST AND FRY'S READABILITY GRAPH

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#### 4.1 Introduction

This chapter comprise an analysis of data collected through the Cloze task, administered to the students and Fry's readability graph. With respect to the research agenda set out in Chapter 6, this is an analysis of the extent to which the language of the science textbook is accessible to the sampled students.

#### 4.2 Readability analysis of the Cloze task text

As discussed in the introduction of this chapter, to estimate the reading age of the science textbook used by grade 7 students, Fry's readability formula was employed. This formula uses the average number of syllables and the average number of sentences per 100 words to determine the readability of text for its targeted audience. Fry's readability formula provides a numerical value which is the American grade level. Following Fry (1968), these grades are converted to reading ages (in years) by adding a value of 5. In this research, each of the Cloze tasks was divided into three parts of about a hundred words in complete sentences. The data in Table 4.1 present the various Fry's readability results for the Cloze passages used in this investigation.



**Table 4.1 Average number of sentences, average number of syllables and reading age for the three extracts**

Extract	Average number of sentences per 100 words	Average number of syllables per 100 words	READING AGE (in years)			
			Section 1	Section 2	Section 3	Average
Unit 3	7.6	146.6	15.5	15.5	13.8	14.8
Unit 4	6.6	150.3	15.5	16.6	17.4	16.5
Unit 6	7.1	144.3	16.0	17.0	13.2	15.4

Table 4.1 indicates that the passages cover a range of reading ages<sup>14</sup> from 13.2 to 17.4. As the average age of students in grade 7 is 12 years old, the findings suggest that the textbook is far above the reading comprehension level of the intended readers and would be unlikely to be found readable and comprehensible by majority of the students. Indeed, researchers such as Johnson (1998) have suggested that science textbooks should have a reading age at least two years below the reading age of the students because they are frequently used as unsupported texts, for homework or revision, without direct teacher support. Moreover, advocates of readability formulae argue that readers who are non-standard English speakers, as is the case for most Jamaican students, should be placed at least a year behind their USA counterparts (Ayodele, 2013).

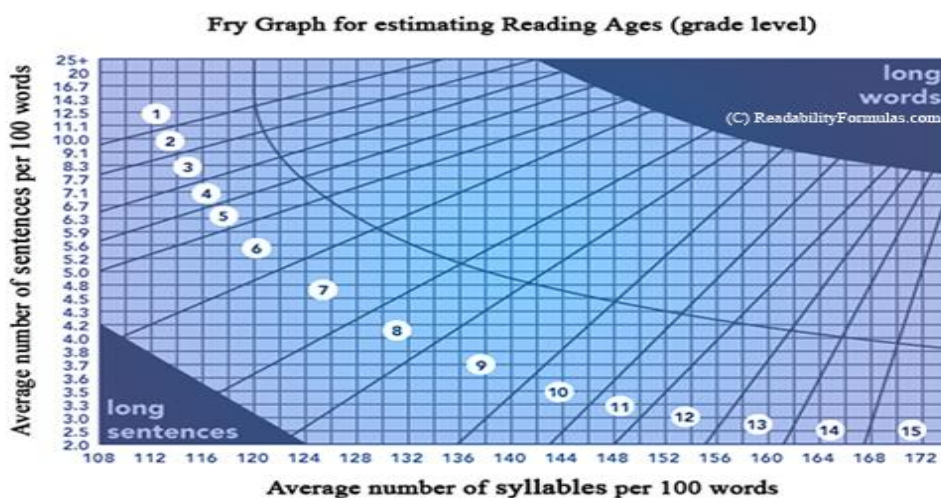
Though alarming, these results are not surprising since they confirm past research and reinforce the findings of many international research that most science textbooks are above the reading age of the target readers (Aldahmash et al, 2016; Khine, 2013; McDonald, 2015). Furthermore, the findings are also consistent with those of local researchers (Lodge, 2002;

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<sup>14</sup> The term reading age is used to indicate the chronological age of a reader who could just understand the text. Additionally, in the context of this research, the term is also useful when applied to the text itself. For example, a text with a reading age of 12 years is one that could be read and just understood by a 12-year-old pupil having average reading ability (Johnson, 1998).

Myers, 1998; Shillingford, 1990; Thorpe, 1994). These researchers all reported that science textbooks used in the Jamaica were difficult for the target students to read and comprehend. Fry's readability formula was also used to determine the relative difficulty of the vocabulary and sentence length of the passages. As the points obtained in each extract were above the curve of the graph (see Figure 4.1), i.e. top right, it appears that the science textbook has a higher than average vocabulary difficulty. Furthermore, all three extracts also contain many new scientific multisyllabic words; the meaning of the passages is almost totally carried by these multisyllabic words. To illustrate this point, if one reads the following paragraph from the textbook under investigation, but saying 'blank' for all the underlined, multisyllabic words, it would be almost impossible to achieve any level of comprehension from the passage.

During pollination, pollen travels to the stigma. Each grain of pollen then makes a tube down into the style to the ovary. In the ovary are the egg cells inside the ovules. The pollen tubes grow into the ovules. The male part from the pollen joins together with the female egg cell and fertilisation occurs. (Mitchelmore, 2009, p. 79)



**Figure 4.1 Fry's Graph for estimating reading ages (grade level)**

These results also support findings of Fang (2006) whose study on the language demands of science reading in middle schools in the USA pointed to the significant comprehension challenges that even students who were proficient readers encountered because of a heavy concentration of technical terms within a sentence. The results are also consistent with the conclusions by other research studies that demonstrate that school science textbooks contain

a high load of science vocabulary which is difficult even for native English speakers (Kahveci, 2010; McTigue & Scott, 2010; Song & Carheden, 2014).

The difficulty level of the textbook could also be attributed to the long word length per sentence. For example, in Unit 3 under the heading 'Reproduction in vertebrates', there were three 15-word sentences, one 18-word sentence and one 19-word sentence. In unit 4, under the heading 'Alcohol abuse', there is one 19-word sentence, one 20-word sentence and one 23-word sentence. Additionally, in unit 6, the 100-word sample under the heading 'Volcanoes in the Caribbean' contains one 14-word sentence, two 16-word sentences and two 18-word sentences. In all these cases, it is very doubtful that many pupils, when they eventually reach the full stop, could remember what the beginning of the sentences was about, much less extract the essential meaning from it. Moreover, considering the low motivation of Jamaican students to do science and to read science textbooks (Whiteley, 2015), it is very unlikely that these books would be of interest to potential readers. Although few researchers have been directly concerned about how interest influences the comprehension and recall of expository text, several studies seem to support the hypothesis that motivation plays an important role in reading comprehension (Cuevas, Russell & Irving, 2012; Guthrie et al, 2006).

It must be noted, however, that the validity and utility of quantitative formulae, such as the one advocated by Fry (1968), have been questioned by several reading researchers (Bagency & Greene, 2014; Zamanian & Pooneh, 2012), particularly because they are predominantly based on only two variables (word length/frequency and sentence length) that may not be appropriate predictors of language difficulty. Their limited scope of data (i.e., relying principally on vocabulary and syntax) and low reliability compromise their use.

Readability results can also become inflated by the frequent presence of the same multisyllabic word in the sample. For example, in unit one of the textbook sampled the three-syllable word *chemical* appeared eight times on a single page (see p. 23). Though clearly a multisyllabic word, it is commonly used in a science class and not particularly challenging to the intended seventh-grade readers. Additionally, formulae that rely on word length may underestimate the difficulty of science because, as Gunning (2003) points out, a simple measure of word length does not consider the abstractness of the word or the use of uncommon meanings.

Readability formulae also fail to consider that learners bring to the task not only vocabulary and structures, but also motivation, interest, background knowledge and outside experiences (Pakulsiki & Kaderavek, 2012). It is possible that material that is interesting to students is easier for them to read because they are motivated to read it. Conversely, other people with similar reading skills may find the material uninteresting and much more difficult to read. Thus, considering the number of factors that formulae fail to consider, Fry's readability formula can only provide an approximation of the level of difficulty. Consequently, the findings here must be viewed with caution.

### **4.3 Cloze test analysis**

The reading level of the students was determined using a Cloze test (see Appendix D). The Cloze test instrument used in this research consisted of nine Cloze passages totalling 1000 words. Three passages were selected from each textbook near the beginning, middle and towards the end of the book. The whole caption of each passage was provided for the students along with the first sentence of each passage. Beginning with the second sentence, every seventh word was deleted and replaced by a blank space. The blanks were all approximately of the same length. Students were credited with marks only if their answers were identical to the words deleted (Pikulski & Tobin, 1982).

The reliability of the test was done by using the Guttman (1945) split-half method. This was done by counting the number of correct words students scored in the passage on 'Reproduction in vertebrates'. The passage was divided into two parts, each with 25 blanks. The number of correct words in each part was then converted to a percentage score. The reliability calculated using the Guttman split-half method was 0.85. The procedure was repeated for the 'Alcohol abuse' and the 'Volcanoes in the Caribbean' passages. The reliabilities obtained were 0.82 and 0.87 respectively. This suggests that the tests were reliable and suitable for the study.

The results of the Cloze tests indicate the extent to which the students in this sample could read and understand the science textbook under examination. The results of the distribution of scores are presented in Table 4.2. The conclusions drawn are based on the reading level categories outlined by Wellington and Osborne (2001). They suggested that a frustration level occurs when a student score is between 0% and 39%; this means even with instruction the textbook will probably be too difficult for learning. Instructional level refers to a situation

where a student score is between 40% and 59%; this means that a student experiences a reasonable difficulty level, so that the textbook is suitable for learning with teacher instruction. Independent level, according to Wellington and Osborne, occurs when the student score is between 60% and 100%, indicating that the student could effectively learn science from the text with minimal or no teacher instruction.

On the whole, the results, as presented in Table 4.2, indicate that approximately 20% of the total sample of the students read the science textbook at the independent level. About 32% and 47% of students are categorised in the instructional and frustration levels respectively. This suggests that the *Investigating Science for Jamaica Book 1* is suitable for approximately 32% of the students given some teacher support in terms of guidance and structured reading, and that almost half the students (47%) will find the texts too difficult, even if aided by their teachers. These findings support the results of the Fry readability formula (Table 4.1) and the findings of Soyibo (1996). They are also consistent with those of Lodge (2002), Myers (1998), Shillingford (1990) and Thorpe (1994), that textbooks in science disciplines being used in Jamaican schools are in many ways unsuitable for the target students. These results have serious implications for effective teaching and learning of science, especially considering the high dependency on science textbooks in the Jamaican context.

**Table 4.2 Percentage of students who were categorised as independent, instructional and frustration readers based on their scores in the Cloze test**

		Frequency	Percent
<b>Valid</b>	Frustration	70	47.0
	Instructional	48	32.2
	Independent	31	20.8
	<b>Total</b>	<b>149</b>	<b>100.0</b>

Table 4.3 shows, although the sample sizes are small, that there is a relationship between the school types and the students' reading levels. This is clear from the percentage of students reading at the independent level at the traditional high (38%) which is higher than for the other school types. The Cloze test scores also revealed that the highest number of students

reading at frustration levels were in the upgraded high (approximately 70%) and the junior high school (75%).

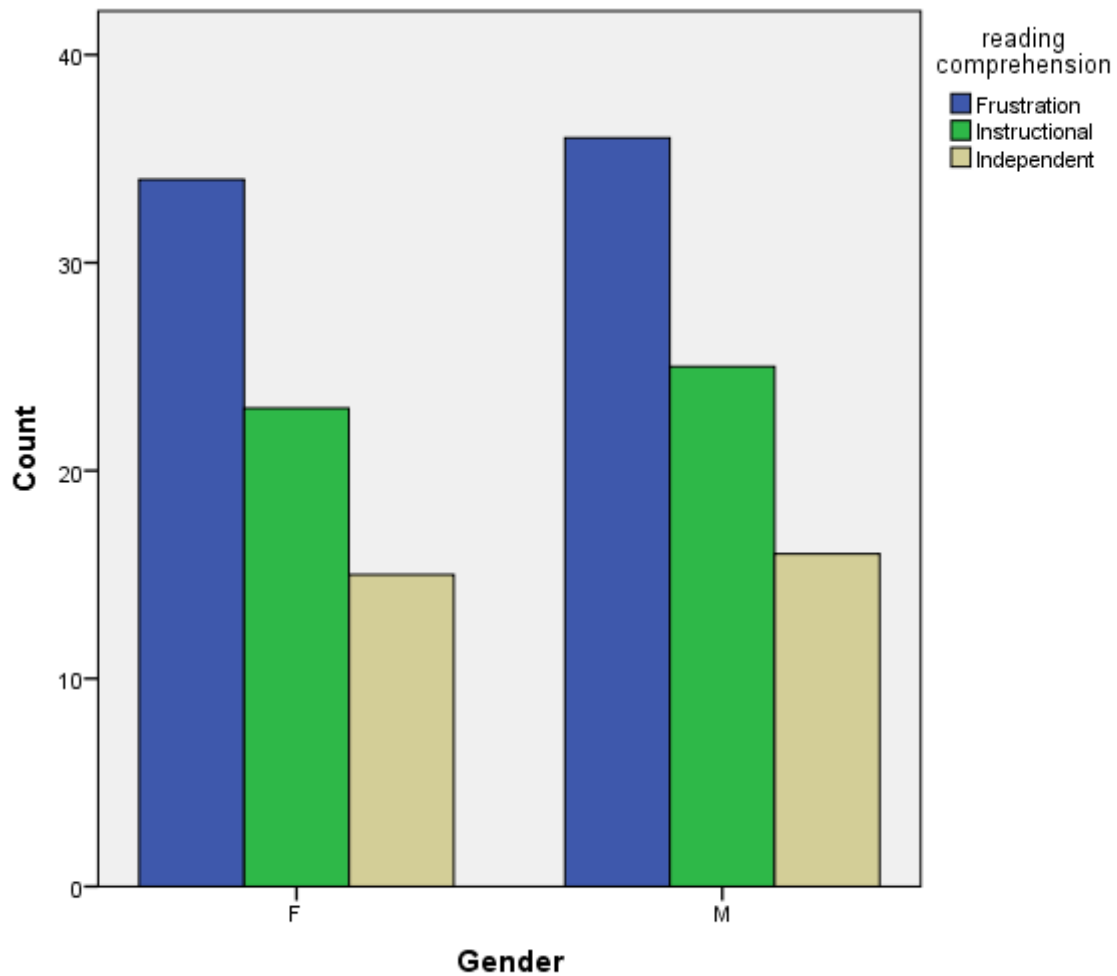
One consistent finding is that traditional high school students outperformed their counterparts in the technical, private, upgraded and junior highs. This is not surprising, since access to quality education in Jamaica remains largely determined by societal class, a fact evident not only in the differential resources available to schools but also the background of students entering better-resourced institutions. Thus, traditional high schools in Jamaica usually attract the more academically gifted students from middle and upper class strata in the society, while those from marginalised socio-economic backgrounds end up in the upgraded and junior high schools. Moreover, traditional high schools have more well trained university graduate teachers than other schools. These factors are likely to have far-reaching implications for how much these students are able to read and understand scientific discourse presented textbooks.

**Table 4.3 The reading comprehension of students based on school types**

			Reading Comprehension			Total
			Frustration	Instructional	Independent	
School Type	Private	Count	1	14	6	21
		% within School Type	5%	67%	29%	100%
	Traditional High	Count	0	15	9	24
		% within School Type	0%	63%	38%	100%
	Technical High	Count	20	8	8	36
		% within School Type	56%	22%	22%	100%
	Upgraded High	Count	22	6	4	32
		% within School Type	69%	19%	12.5%	100%
	Junior High	Count	27	5	4	36
		% within School Type	75%	14%	11%	100%

Interestingly, the results also reveal that there was no difference between the performance of male and female students who use the grade 7 science textbook (see Figure 4.2). This finding agrees with international studies undertaken in respect of students' performance linked to their gender (see, for example, Eze, 2015; Fatoba 2014) but differs from the findings of local researchers such as Mckenzie-Briscoe (1997) and Myers (1998). These local researchers have reported that girls did better than boys in most cases.

**Figure 4.2 Students' reading comprehension as a function of gender**



## CHAPTER 5

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### ANALYSIS OF THE VISUAL REPRESENTATION IN THE TEXTBOOK

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#### 5.1 Introduction

In the second of my results chapters, I present the findings for the analysis of the visual representation of the science textbook. More specifically, the chapter presents the findings for the portrayal of race and gender in the textbook. In addition, in Chapter 1, Rastafari was presented as one of the most maligned and marginalised groups in Jamaica. This chapter presents the findings of how they are visually represented in the textbook. In line with my discussions of the Cloze test results in the previous chapter, I start by explaining the methods I used to analyse and present the data. The images selected for the analysis of this study were selected from the textbook under investigation (Section 3.4).

As a final note, complexity of race and gender-difference in imagery, and the interpretive difficulties they present, have been well-documented (see, for example, Hall, 1997). Thus, to what extent these results can be used to draw definitive conclusions on how racializing and gendering of science textbook affect Jamaican students' accessibility and, ultimately, their career choices and way they understand science, must remain an open question, at least in the context of this research. Indeed, the range of factors influencing young people's views is large and the importance of language and visual images in textbooks may be small. However, I believe an analysis of this nature is of special interest, as it provides a very good opportunity to bring race and gender representation in science textbooks into the mainstream and consideration of these issues may help guide decisions made by authors and publishers in their continuing revision of current Jamaican science textbooks and the development of new curriculum materials.

#### 5.2 Methods of analysis

A combination of content analysis and the principles of social semiotic theory outlined by Kress and van Leeuwen (2006) are used to examine the representation of race and gender in the visual images. The tradition of content analysis of texts has the advantage of yielding quantifiable information and allows for general statements to be made about aspects of



representation which both non-specialists and experts can understand. However, Bell (2001) reminds us that content analysis alone is rarely able to support statements about consequence or interpreted meaning of a domain of representation. As such, many scholars have proposed a combined semiotics-content analysis approach (Leiss et al, 1997).

Semiotic analysis has the advantage of enabling a richer analysis of texts by exploring the affordance of images, which to some degree accounts for differences in what, and how, images mean. This combined approach has been effectively utilised by researchers such as Bell and Milic (2002) to analysis gender stereotypes in display advertisement. Details of this approach is outlined below.

### *5.2.1 Content analysis*

With respect to gender, females and males appearing in drawings and photographs were counted both by the number of individual people illustrated and by the total number of illustrations for each gender. In all the drawings, the gender of the individuals was clearly identifiable (gender in this analysis is defined as a dichotomous form of cultural categorisation and is signified by means of standard attributes such as clothes, hairstyles and facial features). The categorisation of male and female photographs was, however, somewhat more problematic. In five photographs, it was not possible to verify the gender of individuals represented due to their positioning as indistinguishable figures in the background-fuzzy photographs or photographs without the person facing the camera. These instances were excluded from the analysis. In addition, ten illustrations which were genderless (stick figures or otherwise depicted as genderless) were not tabulated.

In terms of race, the illustrations of people in the textbook were classified into six categories: African-Jamaican; Chinese-Jamaican; European-Jamaican; Inter-racial-Jamaica; Indian-Jamaican; and 'unidentifiable' (defined as one whose race could not be determined based solely on the illustration or photograph in the textbook). These racial groups have been identified by Carpenter et al (2007) as comprising the Jamaican population. For this study, illustrations of people were identified using their phenotypical characteristics. The phenotype characteristics for these categories differed primarily in terms of skin shade, hair texture and lip colour. Other secondary features included shape of nose and shape of face. The coding was limited to illustrations of human figures. Figures' faces had to be at least half visible to

be coded. Figures drawn from behind or with hair or clothing that concealed the face were excluded. A total of eight images were therefore excluded.

The data were coded by three coders, two of whom had not been involved in any previous aspect of the research process. After some discussion of the criteria for each category, the coders were each given a copy of the textbook and asked to independently classify the images based on the characteristics belonging to each gender and racial category. Interrater reliability was determined by using Cohen’s kappa in SPSS. Table 5.1 provides an interpretation of Cohen’s Kappa.

**Table 5.1 Interpretation of Cohen’s kappa.**

<b>Value of kappa</b>	<b>Level of agreement</b>	<b>% of data that are reliable</b>
<b>0-0.19</b>	None	0-4%
<b>0.2-0.39</b>	Minimal	4-15%
<b>0.4-0.59</b>	Weak	15-35%
<b>0.6-0.79</b>	Moderate	35-63%
<b>0.8-0.9</b>	Strong	64-81%
<b>Above 0.9</b>	Almost perfect	82-100%

Strong agreement was reached in coding at .88 for the racial categories and .80 for the gender categories; these are above the minimum acceptable level of 0.70 suggested by Peat (2001). With respect to race, the initial coding scheme included Arab and Jewish-Jamaicans but these were subsumed within the category of unidentified since the interrater reliability was low. Interrater reliability was much higher for African-Jamaicans (.95) and European-Jamaicans (.90). All the individuals whose apparent race could not be identified were coded as unidentified and excluded from subsequent analyses of racial differences. Interrater reliability was also strong for the three content analytic variables: gaze (.80), social distance (.85) and angle of interaction (.80).

A limitation of using content analysis to analyse gender and racial representations is the problematic nature of identifying race and gender based on visual markers on the body. Racial and gendered identities are complex constructs with changeable and capricious social meanings. Thus, a person’s self-identification might differ from the labels assigned to them

based on their physical features (Omi & Winant, 1994). In this sense, it is possible that coding for apparent gender and race on the basis of physical features might misrepresent the self-identification of the represented participants in some cases. At the same time, gender and racial categories have a legitimate claim to physical reality (Coates et al, 2017), as well as a natural psychological basis that facilitates understanding differences that cut across categories (Prentice & Miller, 2007). This is an issue to which I return in Chapter 8. I raise it here to draw attention to one of the limitations of the use of content analysis in visual representation.

### 5.2.2 Social semiotics analytic framework

Specific attention was given to Kress and van Leeuwen's (2006) three metafunctions for interpreting visual images: *representational* (focussing on the patterns of experiences (as configurations of processes, participants and circumstances) and the logic-semantic relations between them); *interactive* (how the image producer and viewer interact, on the one hand, and how they interact with the depicted elements, on the other); and *compositional* meanings (how visual elements are placed in the visual text).

In this study, four dimensions for narrative representation captured the role of each participant:

- Participants could be an actor doing something to another participant
- Participants could be a 'reactor' to a model, object or situation, represented in the visual imagery
- Participants could be the target of another participant's action
- Participants could be an 'expressor' or 'behavior', performing a non-transitive action such as smiling or running.

Analysis of the narrative structure was also extended by adding two contrasting types of action based on what is represented in the dataset: *social* (e.g. children playing marbles or football in the playground); and *institutional* (such as students performing laboratory experiments). Apart from processes and 'represented' participants, narrative structure also contains secondary participants, which Kress and van Leeuwen (1996, 2006) describe as circumstances. In this study, circumstances of setting describe the location of the participants' circumstances of means refer to the tools used in the action processes such as laboratory

equipment, and circumstances of accompaniment refer to situations in which participants are not linked by a vector.

As for conceptual structures, participants depicted in an analytic way were shown with their physical parts articulated to a degree that emphasised part-whole relationships. Participants represented in a symbolic way were shown by highlighting one of the attributes for display and implying its similarity to something else. Images were categorised as 'non-conceptual' if there were no relationships illustrated.

With respect to the interaction between the viewer and the images, Kress and van Leeuwen (2006) identified four dimensions: gaze direction, social distance (visual techniques), vertical angle and horizontal angle. These semiological dimensions are adapted for use in this analysis and a description of the framework is provided below.

Two kinds of gaze were coded: one where the participant's gaze is at the viewer (demand), and one in which the participant's gaze is away from the viewer (offer). In addition, two levels of social distance (visual technique) were distinguished: intimate and impersonal. At the intimate level, the camera is too close to the participant and thus a magnified view of him/her is captured. At the impersonal level, the participant is shown from a public distance and there is space around them, showing context (Bell & Milic, 2002).

The angle of interaction (the angle from which the participants is seen by the assumed viewer) is structured by both the horizontal (frontal versus oblique) and vertical (low, medium and high) planes. Participants shot from a high angle were coded as high, those shot from below were coded as low angle and those at the same height as the assumed viewer were coded as medium. In addition, with respect to the horizontal plane, participants shot from a frontal angle appear near or in front of the vanishing points while those shot at an oblique angle are positioned to the left or right of the vanishing points.

The compositional metafunction deals with the way in which the representational and the interactive metafunction come together into a meaningful significant whole. Meaning is built by three interrelated systems: information value, salience and framing. These systems are not restricted to single pictures, but they apply also to composite visuals.

Informational value is associated with the placement of elements in relation to each other. Kress and van Leeuwen (2006) argue that the value of an element perceived by the viewer on

the left side of the images may be considered as old information, whereas those on the right side are to be decoded as new. Elements on top can be interpreted as ideal whilst the lower section focuses more on the factual and real. Saliency refers to the method in which the elements in the composition are positioned to attract attention to various degrees (Jewitt & Oyana, 2001). For instance, a foregrounded image is more salient than one placed in the background. Saliency can be determined by considering factors such as tone, size, contrast, colour, focus, perspective and overlap. In this study, the extent to which the textbook images were salient was determined by considering the size and positions of the represented participants relative to each other.

With respect to modality, the following graduation modality markers were considered in order to define the degree of modality of the visual images:

- Colour saturation – scale running from full colour saturation to black and white
- Colour differentiation – scale running from a maximally diversified colour range to monochrome
- Brightness – scale running from maximum number of different degrees of brightness to just two degrees (black and white; two brightness values of the same colour)
- Illumination – scale running from maximum representation of the play of light and shade to the absences of it.

Here, three levels are identified: high (images use differentiated saturated colours naturalistically, detailed background and representation of the participant), medium (images use less differentiated saturated colours, lightly sketched background and less detailed representation of the participants) and low (images that are similar to drawings, relying on limited range of colours and low degree of the articulation of details).

### **5.3 Participant type**

There was a total of 405 participants, across both the human (101, 30%) and non-human (304, 70%) categories. An impersonal view of science may well be conveyed by such a large number of 'human-free' illustrations, which may have implications for gender perceptions and preferences.

#### 5.4 Participants and gender

The total numbers and percentages of illustrations of males and females are shown in Table 5.2. There appears to be a tendency for more males than females to be represented in the illustrations but this does not reach statistical significance ( $\chi^2 = 2.23$ , 1 df,  $p > 0.05$ ). These data support the findings of much of the previous research undertaken in this area. For instance, Walford's (1980) examination of the illustrations in 13 introductory science textbooks in the USA found twice as many images of men as of women. In much the same vein, Elgar's (2004) investigation of gender equity in lower secondary school science textbooks reported that photographs depicting males were four times as numerous as those depicting females. Similar findings have also been reported in more recent studies (see, for example, Moser & Hannover, 2014; Ullah & Skelton, 2013).

**Table 5.2 Distribution of types of male and female illustrations in the textbook**

TOTAL NUMBER OF PAGES	TOTAL NUMBER OF PARTICIPANTS	GENDER	
		Male	Female
170	101	58 (57%)	43 (43%)

#### 5.5 Representational meanings

The data in Table 5.3 suggest possible differences between narrative role and the gender of the represented participants. Males were depicted more frequently as active participants than females but this difference was not statistically significant ( $\chi^2 = 0.35$ , 1 df,  $p > 0.05$ ). In addition, the table also shows that males depiction as 'goals' of the other participants' actions were four times that of females and this difference was statistically significant ( $\chi^2 = 9.86$ , 1 df,  $p < 0.05$ ). Further scrutiny of the data show statistically significant differences between participants depicted as 'expressor' and their gender ( $\chi^2 = 15.5$ , 1 df,  $p < 0.05$ ). Indeed, women were three and half times more likely than men to express emotions. Only seven 'reactions' images were found and these were as likely to be displayed by both males and females. These findings are in line with those reported by Bell and Milic (2002) in their replication of Goffman's (1976) examination of images in American magazines. These authors found that males were more frequently shown as 'actors' than females. The results may be interpreted

ideologically as the dominant position of males and the submissive and weak positions of females.

**Table 5.3 Narrative role and gender of represented participant**

NARRATIVE					
	ABSENT	ACTOR	GOAL	EXPRESSOR	REACTION
MALE	0 (0%)	23 (42%)	25 (46%)	5 (9%)	2 (4%)
FEMALE	1 (2%)	17 (38%)	6 (13%)	18 (40%)	3 (7%)

Table 5.4 presents the results for the types of conceptual representation and the gender of represented participants. On the whole, it appears that females are more commonly depicted in ‘conceptual’ ways than are males. More than half of all the images show men and women in ‘symbolic’ ways. A chi-square test of independence showed a statistically significant relationship between the types of conceptual representation and the gender of the participants ( $\chi^2 = 9.47$ , 2 df,  $p < 0.05$ ).

**Table 5.4 Conceptual representation and gender of represented participant**

TYPES OF CONCEPTUAL REPRESENTATION			
	Non-conceptual	Analytic	Symbolic
MALE	17 (29%)	11 (19%)	30 (52%)
FEMALE	11 (26%)	12 (28%)	20 (47%)

## 5.6 Interactive meaning

Table 5.5 presents the results for the angle of eye direction (gaze) in the images for each gender in the textbook. As is evident, females gazed away from the assumed viewer more frequently than males. Indeed, only 23% of females looked at the viewer in comparison to 62% of males. There were statistically significant differences in the relationship between gaze and the gender of the represented participants ( $\chi^2 = 17.6$ , 2 df,  $p < 0.001$ ). These findings seem to refute Lutz and Collins' (1994) assertion that "those who are culturally defined by the West as weak – women, children, people of colour ... are more likely to face the camera, the powerful to be represented looking elsewhere" (p. 370).

Interestingly, the above data contrast with those reported by Bell and Milic (2002) who found that men were more likely to be depicted at a 'public' distance and women at close-personal or intimate distance. Furthermore, the results also seem to refute Dyer's (1982) assertion that men do not have the tendency to gaze at the viewer because they see this action as an indicator of being weak and passive. Jamaican males are strongly encouraged to gaze in the direction of the viewer and demand something from them (Bailey, 2002; Evans, 1999; Parry, 2004). Bailey (2002) sees this as an expression of hegemonic masculinity.

**Table 5.5 Gaze and gender of represented participant**

DIRECTION OF GAZE			
	DEMAND	OFFER	NO GAZE
MALE	34 (62%)	14 (26%)	7 (13%)
FEMALE	10 (23%)	29 (13%)	6 (13%)

With respect to the horizontal angle of interaction, Table 5.6 shows that the majority of the images were shown from a frontal angle for both males and females. This suggests that most of the represented participants were portrayed at what Kress and van Leeuwen (2006) describe as the higher level of viewer involvement. Similarly, oblique angles (which, according to Kress and van Leeuwen (2006), represent detachment from the viewer) were approximately equal in percentage for both genders. These findings suggest that the



frontal/oblique dimensions were not linked to the gender of the represented participants and support the findings of Bell and Milic (2002).

**Table 5.6 Horizontal angle and gender of represented participant**

HORIZONTAL ANGLE		
	FRONTAL	OBLIQUE
<b>MALE</b>	39 (71%)	16 (29%)
<b>FEMALE</b>	32 (73%)	12 (27%)

The data in Table 5.7 concern the relationship between the vertical angle and gender of the represented participants. As we have seen in Kress and van Leeuwen's (2006) *Reading Images*, vertical angles serve to represent the power relationship between the image-producer and represented participants. Thus, a high angle depicts a relationship in which the producer of the image and the viewer have symbolic power over the person or thing represented, whilst a low angle depicts a relationship in which the depicted person has power over the image-producer and the viewer.

As is evident, females more than males were portrayed at a low angle in which the represented participants are depicted from below, towering over the viewer. Following Kress and van Leeuwen (2006), such a model suggests that a greater percentage of women than men are depicted as having symbolic power over the image-producer and the viewer. Further analysis reveal that most of the individuals from either gender were usually photographed from a medium angle (eye level). This would suggest that some attempt has been made by the image-producers to promote gender equality insofar as the vertical angle was concerned.

In contrast with the findings from Bell and Milic (2002), there was a significant difference between the vertical angle from which women, as opposed to men, were framed ( $\chi^2 = 8.38$ , 2 df,  $p < 0.05$ ).

**Table 5.7 Vertical angle and gender of represented participant**

	VERTICAL ANGLE		
	HIGH	MEDIUM	LOW
MALE	6 (11%)	33 (60%)	16 (29%)
FEMALE	0 (0%)	25 (56%)	20 (44%)

Another dimension to the interactive meaning of the images in the grammar of visual design is the social distance. Kress and van Leeuwen (2006) argue that the distance between the participants in the frame and the situation of the image can affect the social distance between the viewer and the participants of the image. The data in Table 5.8 show that males were more likely to be represented in ‘impersonal’ or long shots and females in ‘intimate’ or close up shots with a higher degree of facial prominence than males. However, this difference was not significant ( $\chi^2 = 5.83$ , 2df,  $p > 0.05$ ). From the semiotic perspective, females created a stronger sense of viewer affinity than did males.

**Table 5.8 Social distance and gender of represented participant**

	SOCIAL DISTANCE	
	INTIMATE	IMPERSONAL
MALE	19 (35%)	36 (66%)
FEMALE	27 (60%)	18 (40%)

### 5.7 Compositional meaning

With respect to the informational value, in general, the left-right structure of the display was not sensitive to the gender of represented participants in all but two images (see Figure 5.1 and Figure 5.2). In Figures 5.1 and 5.2 there is a clear left/right system. The female carriers are presented in the left visual field and the male carriers in the right visual field. In such a

situation, the compositional meaning of the female carriers represents the given (what is known) and the male carriers represent the 'new'. Thus, from the perspective of the informational value element, male carriers have superiority over the female carriers.



**Figure 5.1 Students measuring their height with a measuring scale**



**Figure 5.2 Students observing change of states**

With respect to the salience element, the compositional meaning is activated through the size of the represented participants. In all cases the represented participants were positioned in the foreground, without any notable difference in the precision of the outline. This suggests that this aspect of the textbook imagery promoted gender equality.

## **5.8 Modality**

With respect to modality, the visual images examined are presented as naturalistic, unmediated, un-coded representation, foregrounding content rather than calling attention to its production. Thus, the images were highly modalised, evidencing a full saturation of colours and a maximally diversified colour range. Kress and van Leeuwen (2006) argue that the higher the degree of modality is, the more credible the represented message will be. Thus, the high modality at play here shows the participants in a 'factual' or 'realistic' context. The majority of the images were in colour and the play of lights provides these images with an aura of naturalism. Indeed, naturalism seem to be a fundamental characteristic of the form of representation manifested in these images. However, modality differences were not strongly linked to the gender of the represented participants.

## **5.9 The social setting**

From the social perspective, the data reveal that, in general, there are more social actions that relate to males than females (36 males vs 25 females). The most commonly depicted illustrations in this category are of children involve in sporting activities such as cricket, football and netball. Thus, the actions portrayed are mostly 'playing' actions. There is also an assumption of gender stereotyping where typically some sporting activities are presented in the textbook's illustrations as masculine and others as feminine. For example, there is an image of boys playing cricket (Figure 5.3) and another of girls playing netball (Figure 5.4). The omission of girls from Figure 5.3 reinforces the traditionally gendered, masculinist nature of cricket, whilst the exclusion of boys from the netball game in Figure 5.4 conforms to dominant understanding of netball being an exclusively female sport. In Jamaica, cricket is perceived as an aggressive activity that precludes female participants, whereas netball, despite being vigorous, is seen as a feminine discursive practice. It could well be argued that these conflicting discourses help to define visual representation in the textbook as a site of gendered inequity.



**Figure 5.3 Boys playing a game of cricket**



**Figure 5.4 Girls playing netball**

Another social action type that is considered for analysis is what I will describe here as ‘domestic’ actions. Domestic in this analysis refers to actions relating to the running of a home or family. With respect to domestic actions, in general, the data reveal that the textbook gave equal prominence to the number of occurrences of females and males (12 for females, 12 for males) but was less balanced when these were divided in to separate categories. For example, more females were depicted in cleaning or cooking and ‘nurturing’ actions than were males (though the sample sizes are small and statistical significance is not claimed). These actions accounted for just over 15% of the images in this category. Correspondingly, more males were illustrated in ‘fixing’ actions (such as fixing a punched tyre) and ‘driving’ actions than females.

In Figure 5.5, for example, the represented participant is a woman cooking, as is mentioned in the caption of this image. Cooking is one of the jobs which is stereotypically believed to be suitable for women in Jamaica. The arms of the woman form a vector directed towards the food. Thus, she is the actor in the transactional action process in which the food is the goal. In other words, the woman is represented as active while cooking. Another example of women's active appearance in stereotypical domestic action is Figure 5.6, in which the woman is depicted as a caregiver. In this image, the woman is placed in the centre with her arms cuddling a baby. Thus, vectors formed by her arms directed at the baby indicate that she is the actor of a transactional action process in which the goal is the baby.

In both the above examples, the female participants represented as actors of the aforementioned transactional processes are depicted as active in a narrative representation, which can be interpreted as ideological because they are ideologically portrayed as active in the stereotypically domestic roles.



**Figure 5.5 Woman mixing and cooking pancakes**



**Figure 5.6 Woman depicted as caregiver**

These findings were not unexpected, given the over-representation of women on these measures in other studies. For example, Courtney and Lockeretz (1971) focussed on the working and non-working roles of women and men and the various types of products with



which they were shown to be associated in the advertisements appearing in women’s magazines. They reported that 90% of women were depicted in roles related to the unpaid labour of house work and child rearing. More worryingly, they found that women were eleven times more likely to be associated with house work than were men. More recently, Reddock (2016) provided evidence to support the view that very little progress has been made in the Anglophone Caribbean with respect to the inequalities reported by Courtney and Lockeretz in 1971.

### 5.10 The institutional setting

Actions that are categorised as institutional are illustrated most frequently in school classrooms or in science and technology workplace settings. The most observable action illustrated, from the institutional perspective, is that of students engaging in practical activities. These illustrations accounted for 55% of all the actions depicted in this category. In one of these illustrations, students were depicted in potentially dangerous situations in the laboratory (Figure 5.7). This image portrays slightly more males than females and this is the general pattern of representation throughout the book. Similarly, in respect of the work place setting, more males are depicted in professional roles compared to females. Such representations might suggest a certain level of gender bias in the images in favour of males.



**Figure 5.7 Students performing experiments in a science laboratory**

Furthermore, although some effort has been made to present a more nuanced gender representation in the textbook, there is still substantive evidence that images depicting

females in the workplace seem to reinforce traditional sex-role stereotypes, such as passivity and occupational limitations. Of the 31 visual images of adult females shown in the textbook, only three were depicted in high-status occupational roles – two as scientists and the other as a doctor. The depiction of women as scientists is noteworthy and marks a welcome shift from the stereotypic image of a scientist as “a man in white coat, with bald head and glasses” (Mead & Metraux, 1975, p. 386).

Nevertheless, in the majority of the images women were portrayed undertaking menial work. In stark contrast, males are depicted in a wide range of professional roles, of which a few examples are scientists, astronauts, doctors. Narrating males and females in this fashion generates certain ontological effect not only at the micro level of everyday social interaction but also at the macro level where social institutions control and regulate the practice of gender. It gives an account, a singular account, about men having much more of an innate talent to succeed in science-related careers in comparison to women, and thus reflects what Walford (1980) described as the ‘masculine face of science’. These narratives are socially constructed and reinforce the assumption and stereotypes surrounding science and gender and may further explain underrepresentation of women in science.

These data support the patterns found in numerous studies examining textbooks within a variety of disciplines, reporting gender inequality not only through analysis of the frequency of images depicting males and females but with consideration to the nature of those images and the way that language is used within textbooks (Bazler & Simonis, 1991; Elgar, 2004; Potter & Rosser, 1992; Whiteley, 1996). Powell and Garcia (1985), for example, in an analysis of 80 science textbooks from both primary and secondary schools, found that men were shown more than women and over 85% of the occupations pictured were represented by men. Similar findings were also revealed in Bazler and Simonis’ (2006) examination of seven secondary chemistry textbooks. These authors found that only one of the seven textbooks achieved gender parity in image representation; the other books overwhelmingly pictured more men than women.

With respect to stereotypic image content, Elgar (2004), for example, in an examination of issues affecting equity in science education for girls and boys, found that males were significantly more likely to be depicted as active in altering the situation around them, than were females, who were more likely to be represented as passive, merely reacting to their



environment. Elgar concluded that such stereotypical representations may have a negative impact on learning opportunities and gender identity. The findings of Elgar's (2004) study are also consistent with those of more recent research (Baker, 2016; Miller et al, 2015; Villar & Guppy, 2015). For instance, Baker (2016) in his review of equity issues in science education reported that men were more often portrayed as dominant or having higher status than women in textbook images.

Whilst recent research may indicate a greater numerical equality among male and female images depicted in textbooks across various subject matters than was the case in earlier decades (Baker, 2016; Miller et al, 2015; Villar & Guppy, 2015), the ways in which males and females are portrayed in textbooks through their actions and apparent personality traits remain sexist. These findings are also supported by the recent investigation of Carli et al (2016) regarding stereotypes about gender and science. They reported that women are perceived to lack qualities needed to be successful scientists, which may contribute to discrimination and prejudice against female scientists.

Further consideration of the text also indicated that images of important people in the field of science were rarely shown. There is a total of six illustrations of scientists described as making important contributions in the Caribbean and elsewhere. Regrettably, only one female scientist was featured: Marie Curie. This disproportionate number of male scientists may suggest to readers that the contributions of female scientists have been less important than those of their male counterparts, thereby reinforcing the gender system.

In both the textbook and the accompanying workbook, Marie Curie is presented not only as a pioneer for finding new elements but also as a hero of science, working meticulously for years on tedious observational experimental work. This is indeed to be welcomed, but I believe the authors missed opportunities to highlight and bring to the fore the achievements of prominent Jamaican female scientists such as Louis Grant, Karen Nelson and Cicely Williams. Perhaps a lack of knowledge, on the part of the authors, of such contributions may have led to this omission.

### **5.11 Analysis of racial categories**

The analysis of images related to race revealed two distinct categories: the clearly identifiable participants belonging to racial groups (95 illustrations, 94% of the total) and those that are

unidentifiable (5 illustrations, 5% of the total). In the clearly identifiable category, the analysis revealed four racial categories: African-Jamaicans, European-Jamaicans, Inter-racial-Jamaicans and Indian-Jamaicans. As can be seen from the data in Table 5.9, the most prevalent group featured in the textbook is African-Jamaican; African-Jamaicans appear in 80 illustrations (79%) of the total). European-Jamaicans and Inter-racial-Jamaicans are depicted in 5% and 9% of the images respectively, while Indian-Jamaicans were only identified in 3% of the images. They were no Chinese-Jamaicans or Arab-Jamaicans represented in the textbook despite these racial groups accounting for approximately 3% of the Jamaican population.

**Table 5.9 Distribution of racial categories in the textbook**

<b>RACIAL CATEGORY</b>	<b>NO. OF OCCURRENCES</b>	<b>PERCENTAGE OF OCCURRENCES (%)</b>
<b>African-Jamaican</b>	80	79
<b>Arab-Jamaican</b>	0	0
<b>Chinese-Jamaican</b>	0	0
<b>European-Jamaican</b>	5	5
<b>Inter-racial-Jamaican</b>	7	9
<b>Indian-Jamaican</b>	3	3
<b>Unidentified</b>	5	5

#### *5.11.1 Representational meaning*

Table 5.10 presents the narrative representation of the participants in the images of the textbook. This analysis shows the active participants of the images in light of the role of each racial category. As is evident, although small sample sizes preclude confident conclusions being drawn, European-Jamaicans, Indian-Jamaicans and Inter-racial-Jamaicans seem to be more likely to be presented as active participants in comparison to African-Jamaicans. In addition, 48% of African-Jamaicans are illustrated performing a non-transitive action such as smiling. No other racial groups were depicted in this way. Although there are very few instances of reactions, they were more likely to be African-Jamaicans.

**Table 5.10 Narrative role and race of represented participant (%)**

NARRATIVE				
	ACTOR	GOAL	BEHAVER/ EXPRESSOR	REACTION
<b>African-Jamaican</b>	29 (36%)	11 (14%)	38 (48%)	2 (3%)
<b>European-Jamaican</b>	5 (100%)	0 (0%)	0 (0%)	0 (0%)
<b>Inter-racial-Jamaican</b>	4 (57%)	3 (43%)	0 (0%)	0 (0%)
<b>Indian-Jamaican</b>	3 (100%)	0 (0%)	0 (0%)	0 (0%)
<b>Unidentified</b>	3 (60%)	1 (20%)	0 (0%)	1 (20%)

#### 5.11.2 Interactive meanings

As outlined in Chapter 2, the system of contact in which a represented participant gazes out at the viewer is referred to as a ‘demand’ image; an image where there is no such gaze is referred to as an ‘offer’ image. As can be seen from Table 5.11, the analysis revealed that the textbook publishers mostly chose images that did not establish any direct eye-contact between the viewer and the represented participants. Demand images were less frequently used. Furthermore, although sample sizes are very small, the data also suggest that contact between the viewer and the represented participants of the European-Jamaicans was more often in the form of a demand. In contrast, African-Jamaicans were more often portrayed in the form of an offer. That is, African-Jamaican were visually represented as objects for the scrutiny of the viewer, whilst European-Jamaicans are represented as “subjects addressing the viewer with their gaze and symbolically engaging with the viewer in this way” (van Leeuwen, 2008, p. 141).

**Table 5.11 Categorisation of the gaze, as defined by eye-contact**

<b>RACIAL CATEGORY</b>	<b>DEMAND (eye contact)</b>	<b>OFFER (non-eye contact)</b>
<b>African-Jamaican</b>	3 (4%)	77 (96%)
<b>European-Jamaican</b>	3 (60%)	2 (40%)
<b>Inter-racial-Jamaican</b>	4 (57%)	3 (43%)

The images also present an interesting juxtaposition of gaze type. Take, for example, the image of the African-Jamaican in Figure 5.8. The image depicts a man looking somewhat dishevelled and in a slumped position. As an image act, there is no eye contact between the represented participants and the viewer, and the viewer is thus in receipt of an ‘offer’ to peruse the image from the perspective of an invisible onlooker (Kress & van Leeuwen, 2006). The viewer is therefore a detached onlooker. Lack of eye contact creates an uneven power relationship between the reader and the represented participant – the viewer is awarded more power than the person depicted. While the viewer is under no obligation to accept the constructions of such social relations, it nevertheless prevents the viewer from empathizing with the social actors depicted. This contrasts markedly with the images of the Indian-Jamaican (Figure 5.9) and the European-Jamaicans (Figure 5.10), whose direct contact with the viewer appears to demand a more immediate response to the depicted scenario.



**Figure 5.8 African-Jamaican depicted as drug addict**



**Figure 5.9 Indian-Jamaican shown rolling her tongue**



**Figure 5.10 Europeans in a spacecraft**

These findings must be seen within the wider context of the social structure in Jamaica. Despite the insistence of governmental institutions and the projected image of a raceless nation, contemporary Jamaican social structure is not simply a matter of class but rather of both class and colour. Gordon (1988), in a study of upward social mobility in Jamaica, adduced evidence to show that social values of worth and economic racialisation are fundamentally determined by skin colour.

Another dimension of interpersonal meaning in visual imagery is social distance. In the context of this study, as discussed in Chapter 3, the concept of social distance carries interpersonal information and suggests a metaphorical relationship between image-subject distance and personal space, such that the close personal distance where one can grasp the other suggests intimacy, while long shots, where the viewer and the one(s) represented are distant, is suggestive of impersonal social distance. The data in Table 5.12 suggest, though again the sample sizes are small, that inter-racial Jamaicans may be positioned to be more intimately acquainted with the viewer than is the case for any other racial categories. Although African-Jamaicans accounted for approximately 80% of the represented participants, just 8% are depicted close up, the remaining 92% being depicted in long shots, suggesting an impersonal interactive distance with the viewer. In this sense, social distance is symbolic; it suggests that the participants shown in long shots are strangers and have nothing to do with the viewer.

**Table 5.12 Categorisation of social distance, as defined by the frame**

<b>RACIAL CATEGORY</b>	<b>INTIMATE (close up)</b>	<b>IMPERSONAL (long shot)</b>
<b>African-Jamaican</b>	6 (8%)	73 (92%)
<b>European-Jamaican</b>	3 (60%)	2 (40%)
<b>Inter-racial-Jamaican</b>	6 (86%)	1 (14%)
<b>Indian-Jamaican</b>	1 (33%)	2 (67%)

The analysis also shows differences in the interpersonal meanings in terms of the angle of interactions (angle from which the viewer sees the participants). Forty percent of African-Jamaicans were depicted from a high angle, compared to only 8% of Europeans and 9% of

inter-racial-Jamaicans. As outlined in Chapter 3, representing participants from a high angle typically indicates that he or she is of a lower status than the viewer. Similarly, a low angle elevates the represented participant in status.

### **5.12 Rastafari**

Visual images of Rastafari were totally absent from the corpus of photographs, pictures and illustrations examined. While I am not suggesting that this was done intentionally by the author and publisher, many studies have pointed to the invisibility of minority groups in textbooks as the most blatant form of discrimination (Adonis, 2015; Sadkler & Sadkler, 1982). Adonis (2015), for example, found that discrimination on the basis of sexual orientation and against disabled people in South African public school textbooks was expressed mostly in terms of invisibility. Similar conclusions were drawn for studies done on the exclusion of some religions from textbooks (see, for example, Waggoner, 2013).

## CHAPTER 6

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### ANALYSIS OF STUDENTS' AND TEACHERS' QUESTIONNAIRES

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#### 6.1 Introduction

This chapter comprises an analysis of the students' and teachers' questionnaire data. In terms of the research agenda set out in Chapter 3, this is an analysis of the students' and teachers' judgment about the extent to which science instructions are accessible, both from the perspective of the science textbook and science classroom discourse. The questionnaires were designed to test the main inferences derived from the Cloze task data analysis.

The questionnaires were distributed personally to the students and teachers in each of the five school types during my visit to Jamaica in June 2016. A total of 465 students and 54 teachers in the five schools completed the questionnaires. The questionnaire contained questions that were presented in a systematic manner to enable the collection of specific information regarding students' and teachers' perceptions about their school science textbook and language usage in various situations (see Appendix C). This allowed me to obtain uniform data that can be compared, summed, and subjected to additional statistical analysis. The statistical data were organised according to the format of the survey instrument and were summarised using tables and figures. The analysis of the questionnaire data presented here, is divided into two sections. The first section provides a detailed discussion of teachers' responses to the items on the questionnaire. The second section deals with students' responses regarding their perceptions of science instructions, making comparisons with the data from the Cloze test and the teacher questionnaire and using descriptive statistics and non-parametric tests where appropriate.

#### 6.2 Teachers' responses

Science teachers' opinions of the textbook studied were investigated through the teacher's questionnaire. The teacher questionnaire was based on the student questionnaire with a few modifications such as some additional questions designed to flesh out the teachers' views on the language of science textbooks and the use of JC as the medium of instruction in teaching science. The questionnaires were administered to teachers at each of the five schools as a group during my visit to the schools. Research indicates that face-to-face administration of



surveys is quicker, more accurate and obtain more returns than a mailed self-completion survey (Burns, 2000). Also, questions to clarify the items can be addressed immediately to ensure that all the respondents understand the items. As a result, a total of 54 teacher questionnaires (a return rate of 90%) were secured for analysis. The questionnaires were statistically computed and analysed using the computer programme Statistical Package for Social Sciences (SPSS). The tables and the charts presented in this chapter were also created using the SPSS programme. To assure confidentiality respondents were given a numerical designation and these were used to present the verbatim comments throughout the analysis. After the questionnaire data were analysed, a sub-sample of teachers was selected from each of the five schools to investigate the research question in more depth. A detailed analysis of the interview data is presented in Chapter 7.

Despite the abundance of research addressing the content and emphasis of science textbooks, as well as how teachers use the texts (Alpasian & Yalvac, 2015; Morris, 2014), there appears to be limited research on how science teachers perceive the role that language plays in science classrooms. Moreover, in the Jamaican context, there is a lacuna of research focussing on the teacher's perceptions of science instructions, including the language of science textbooks and its role in science learning and teaching. Therefore, data in this section are valuable as we can see the obvious strengths and weaknesses of the science instructions from the teachers' perspective.

### *6.2.1 Background of participants*

As part of the survey, respondents were asked to supply personal background information. The demographic data generated from these survey questions were: gender of the participants; the number of years they have taught; and the number of years they were in their current role. Table 6.1 provides a description of these data.

**Table 6.1 Summary statistics for survey participants' demographic backgrounds**

Survey Participants n=54		
	n	%
<b>Gender</b>		
Male	41	75
Female	13	25
<b>Number of years taught</b>		
0-5 years	10	19
6-10 years	14	27
11-20 years	25	48
20+ years	3	6
<b>Length of time in current role</b>		
0-5 years	10	19
6-10 years	14	26
11- 20 years	30	55
20+ years	0	0

As shown in Table 6.1, of the 54 participants, 75% were females (n=41) and 25% were males (n=13). This reflects the overall demographic distribution of the five schools (Evans, 2006). It appears that teaching is still overwhelmingly a female occupation in Jamaica. In terms of experience, as shown in Table 6.1, of the 54 study participants, 52 responded to this item. The number of years each participant had taught ranged from 0 to 30. Nearly half of the teachers in the study (48%) have over 10 years of teaching experience; thus, about half of the teachers could be described as very experienced.

### **6.3 Background characteristic of the students they taught**

Item 5 on the questionnaire asked teachers to describe the background characteristic of the children they teach. It is worth noting that in the technical, junior high and the upgraded schools all the teachers reported that most their students come from a low socio-economic background and were predominantly Creole speakers. Consequently, the students were said by the teachers to experience major problems in speaking and writing Jamaican Standard English. In the words of teacher 46 from the junior high school:

Most of the students are from very poor economic status. They at times find it difficult to understand [scientific] terms that are used as they are not exposed. They normally have interesting ideas but are unable to express them in [Jamaican] Standard English.

In contrast, teachers in the traditional and private high schools reported that most their students are from high socio-economic backgrounds and mainly speakers of Jamaican

Standard English. Indeed, in one traditional high school, one teacher (2) reported that 95% of the students were from 'uptown'<sup>15</sup>. These facts are in accordance with what has already been pointed out in Chapter 6 concerning the way in which the different types of school obtain their populations.

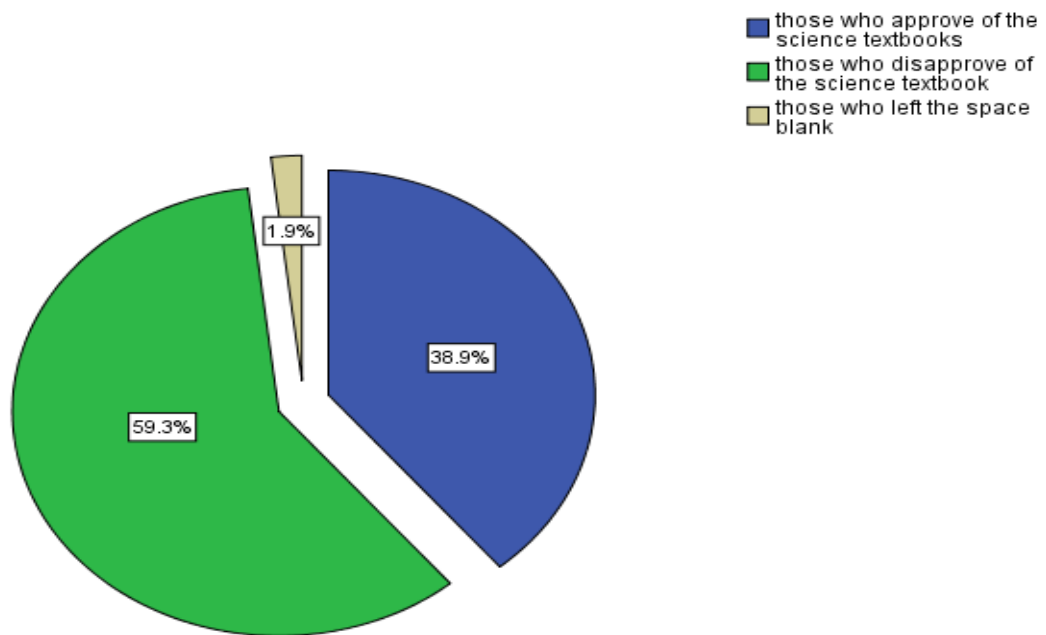
As can be seen from the foregoing analysis, the sampling of the children in this study closely reflects the social realities of the Jamaican school situation. It is well known that children growing up in poor families emerge from schools with substantially lower levels of educational attainment. This interaction between social class and education and mechanism in systems of education that leads both to reproduction of existing class structures and social class bias in what purports to be a meritocracy based on achievement has been expounded by classical sociologists such as Weber (1946) and Bourdieu (1987) and by more recent scholars such as Apple (2013) and Bornstein and Bradley (2014). These writings establish clear links between social class, educational opportunity and patterns of inequality with the system structured in many ways against students from the lower social classes. The educational implications of these findings for science instructions accessibility are far reaching and are discussed in chapter 8.

#### **6.4 Teachers' approval of the science textbook studied**

Data concerning teachers' approval of the science textbook studied were obtained through response to the question "Do you like using your science textbook?" The results pertaining to the educational value of science textbooks used in science discourse were indicative of previous research findings which suggest that many science teachers have a negative evaluation of their science textbooks (Yore & Shymansky, 1991; Shymansky, Yore & Good, 1991; Uyulgan et al, 2011). The response data (Figure 6.1) indicate that 59% of the respondents disapproved of the science textbooks while 39% approved.

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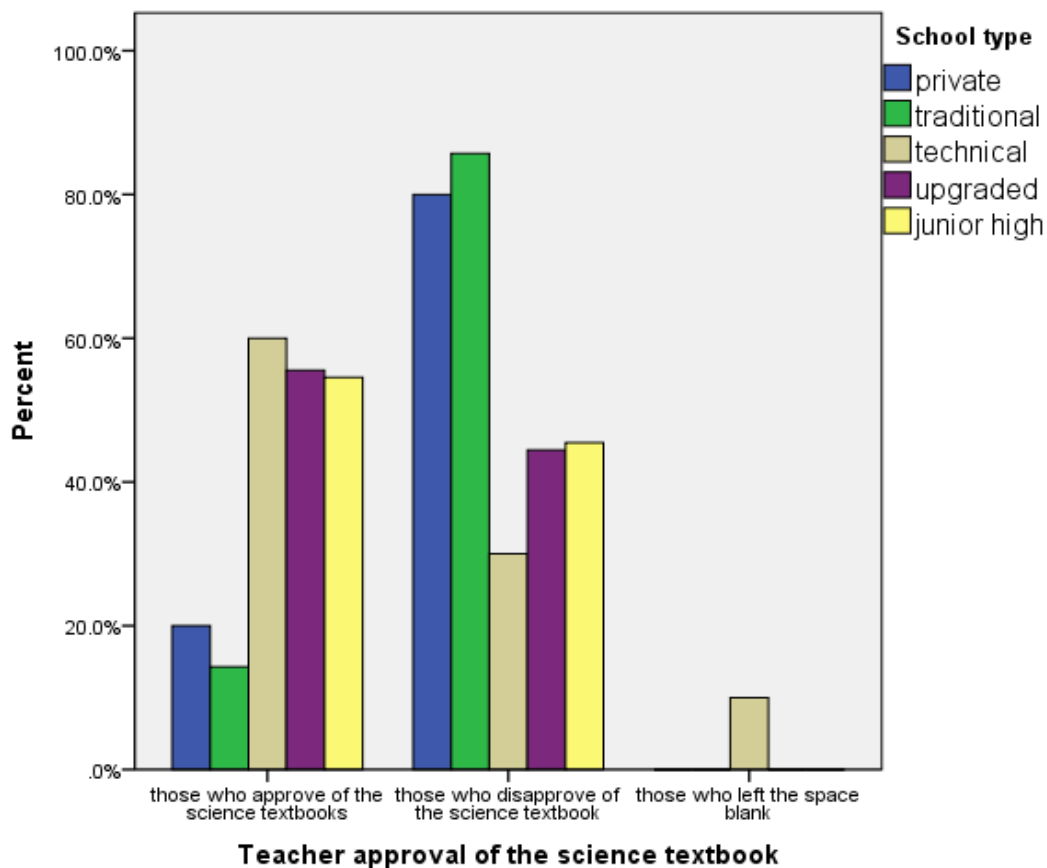
<sup>15</sup> The term 'uptown' is used to describe people who live in the affluent areas of Kingston.



**Figure 6.1 Chart showing teachers' approval of school science textbooks.**

Additional insights can be found in Figure 6.2 regarding teachers' opinions about textbooks that indicate that many teachers in the private high (80%) and in the traditional high school (86%) disapproved of the textbook, whereas the majority of the teachers from the junior high (55%), technical high (60%) and upgraded high school (56%) approved of them. The highlighted contrasting views became more apparent in the teachers' comments. The teachers in the private and traditional high schools complained about the inadequacy of the textbook in leading students to independent learning in the content area. They said that the textbook tries to provide all the answers. The teachers maintained that the textbook does not motivate students to think about the content at all. Since the students find the textbook boring and difficult to read, they force themselves to read and memorise.

As a result, the knowledge gained by the students does not become long term and meaningful. These findings parallel research done by the American Association for the Advancement of Science (2005) which found that high school science textbooks do a poor job in following standards-based principles for concept learning. The evidence also pointed to serious shortcomings in both their content coverage and instructional design.



**Figure 6.2 Teacher’s approval of school science textbooks and school type**

In addition, some teachers were very critical of what they perceive as the unsuitable diagrams and illustrations designed for the students’ grade levels and interest. They complained that the visuals were not well selected, they were not of good quality and that the connection between the visual and the text was not made effectively. For example, teacher 13 commented that “children do not naturally respond to the illustrations, graphics and highlighted items in the textbook and actually need instruction in how to make sense of them”. In this respect, the illustrations, pictures and diagrams do not fulfil the intended overall purpose of drawing out students’ interest and helping them to learn the scientific principles and concepts more effectively (Coleman & Dantzler, 2016; Cook, 2006).

Interestingly, it seemed that the teachers in the junior high, technical high and the upgraded high school believed that the textbook holds content expertise and authority and, is congruent with the local curricula. As teacher 23 commented:

I think that the science textbook is well written and is an excellent teaching resource. It provides guidance for other content decisions: What topics to cover, how much time to allocate to each topic, and in what sequence.

More worryingly, it appeared from the comments of the teachers in the junior high, technical high and the upgraded high schools that for them, the science textbook has become the *de facto* national curriculum. Such an assertion is not unique to the above-mentioned teachers, since it is consistent with the findings of published research from international studies. For example, Pizzini, Shepardson and Abell (1994) reviewed a selection of the most commonly used middle school science textbooks in the United States and found that teachers use them as the legitimate curriculum and seldom question the textbook's ability to meet the needs of the learners. These findings are also authenticated by Baker (2016) and Ramnarian and Chanetsa, (2016) who asserts that science textbooks were being used predominantly as dictionaries by teachers.

In an informal discussion, several reasons were cited by one head teacher in a junior high school to explain the current science classrooms practises, central to what he describes as "the inability of the teacher to move beyond it [textbooks]". He argued that "the overarching fear of students doing badly in the examination deters a teacher from moving away in any respect from the prescribed content and textbook". He further acknowledged that many of his science teachers received little or no training in the subject and because many of them are shaky in their own science background knowledge, hence they rely disproportionately on the textbook.

Further insights into teachers' opinions about science textbooks was achieved by asking respondents "Why do you think that about it?" The outcomes of these responses are summarised in Table 6.2. The table shows that 85% of the responses made by the teachers centred on the reading level of the textbook. These comments on readability addressed the complexity of words and sentences in relation to the reading ability of the reader, the lack of language proficiency, the interest and motivation of the reader and the legibility of the text including type, layout and reading conditions. One teacher (19) from the technical school categorised the textbook as "a book with a heap of facts and vocabulary, that most of my students struggle to understand without supervision", while another teacher (21) from the same school lamented that her students "struggle to derive meaning from not only the difficult scientific vocabulary but also from the diagrams and charts that are frequently used in the textbook". She pointed out that the 'key science words' in the margin at the start of each chapter may prove difficult for even the most advance science students. Other teachers

stated that they find the reading level difficult because the terminologies are not selected carefully and new terms are not defined well. For example, one teacher (9) from an upgraded high school wrote, “I think the science textbook is poorly written. It consists of a lot of challenging scientific terminologies with equally difficult explanations”.

**Table 6.2. Teachers’ comments about the textbook studied**

COMMENTS	N	PERCENT OF CASES
Reading level is not appropriate	38	85%
Too many activities that we do not have resources to do	12	27%
Limited use diagrams, charts and tables	11	24%
Insufficient coverage of course topics	5	10%
Students find the textbook useful	4	9%
Content is clearly presented	4	9%

The foregoing discussion raises some salient considerations in terms of the extent to which science instructions in general and science textbooks in particular, are accessible, especially to students in the junior high, technical high and upgraded high schools. It is axiomatic that these students cannot be expected to develop comprehension in science if the scientific terminologies used in the text are over demanding on students’ abilities. It is also correspondingly true that the students cannot be expected to develop such understanding if purposeful and pointed scientific phraseologies are substituted by ‘simple words’ which cannot accurately express the desired meaning. This, to me is a nuanced position, and it is also one that requires careful consideration to determine desirable terminologies for students at various grade levels.

A surprising result found in the study was the limited reference made by the teachers in the private and traditional high schools to reading challenges of the science textbook among their students. The teachers’ dim views of the textbook would perhaps explain their limited reference to any reading difficulties. It is reasonable to infer that having relied little on the textbooks in their classrooms, the teachers might not be as cognisant about their students’ challenges with manipulating textbook features.

The data also revealed that many teachers (27%) were dissatisfied with the large number of experiments suggested in the textbook, for which they had few or no resources. Some teachers commented that the textbook provided limited activities that encourage the students to use their critical thinking skills. Further, dissatisfaction reported by 27% of respondents concerned the limited use of diagrams, charts and tables; 10% perceived that the textbook provided inadequate coverage of course topics; while 9% of the respondents were dissatisfied with the illogical organisation and presentation of the content.

There were also some positive comments about the science textbook. A few teachers stated that the book was well-written and more interesting than books they used in the past. For instance, one teacher (18) responded that the science textbook she used “has a good mixture of text, diagrams and charts. It is much better than the ‘dry’ England ones we used in the past”. Echoing this sentiment, another teacher (50) emphasised that the textbook was better than those of the past “because it gives you the option to look for specific chapters ... and find any key words to start studying and reviewing”.

The difficult technical vocabulary and the abstract concepts that the textbook frequently employed were highlighted as significant barriers to textbook accessibility from the teachers’ comments. This was evident in their description of the difficulties that their students encounter during science lessons. Teacher 30 stated, “the over emphasis on learning words and definitions are major contributing factors to the difficulties of learning science with textbooks”. Her view was shared by all the other teachers regardless of the performance level of their students and even though the challenge varied across students from different school types.

Unlike the teachers in the private high and traditional high schools, teachers in the junior high schools do not see many problems in textbooks in terms of covering the topics sufficiently. However, they find the content to be far too detailed. They believe that the topics are treated in an encyclopaedic fashion. As a result, the reading becomes difficult and boring. These teachers think that the science textbooks do not help children to distinguish what is important from what is not important. One teacher (36) with 25 years’ experience made the point that if students view science as a collection of facts reported in textbooks, then memorisation of these facts would be a logical approach to studying science. This, he believes, can lead students to prefer memorising, rather than trying to understand scientific information.



Focusing on memorisation may contribute to the development of misconceptions among students that science is a finished body of knowledge, comprising facts, proofs and absolutes to be absorbed.

Teacher 15 with over 13 years' experience teaching in a technical high school alluded to the unattractive way the content was presented in science textbooks. She said:

Students find the textbook boring, and difficult to read. Since the textbook covers the topics in a detailed way, in-depth discussion is ignored. As a result, the topics are dealt with in a superficial way, leading to memorization of the topics, rather than thinking about them.

### 6.5 Frequency of teachers' uses of the science textbook studied

The frequency of teachers' uses of the science textbook studied was obtained from responses to the question "How often do you use textbooks in your science teaching?" Data are presented as Figure 6.3. The results are broadly supportive of the findings of many international studies (Ramnarain & Chanetsa, 2016; Smith, 2017). Sixty-seven percent of science teachers reported that they use their science textbook at least once per lesson and 17% reported that they use them once per week or once every few weeks. No teacher reported that they use their science textbook only for covering absences. Thus, it seems that Jamaican science teachers, as represented by the teachers surveyed are as reliant on textbooks as is reported in the literature (see Section 1.2).

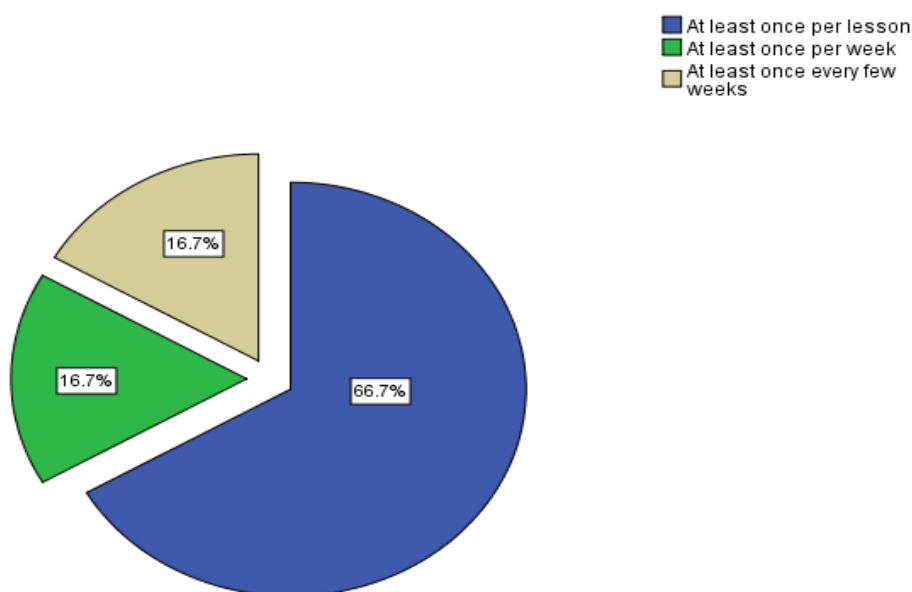
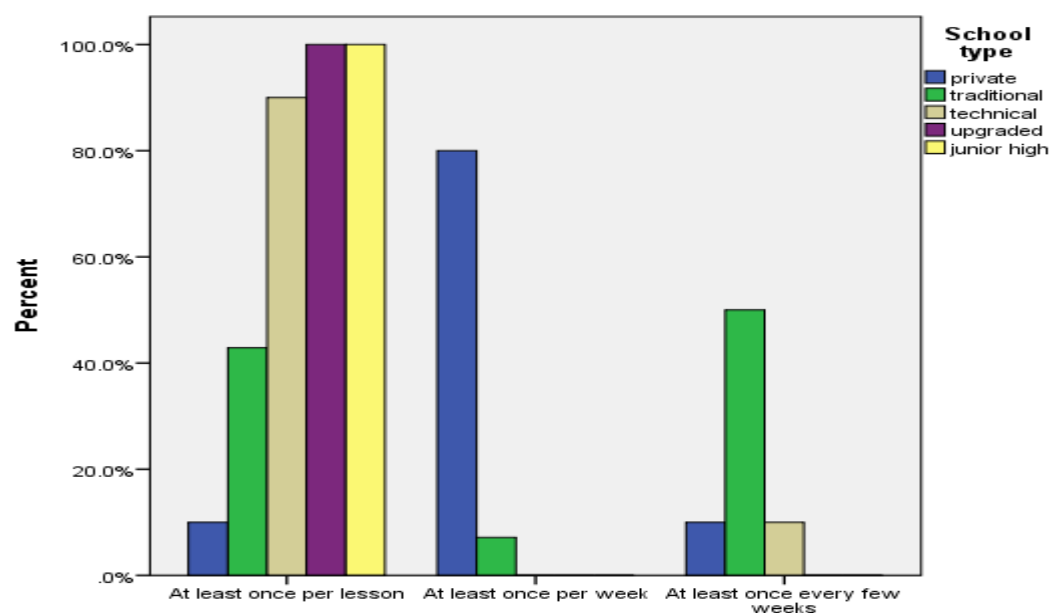


Figure 6.3 Frequency of how often teachers use their science textbook the five school types

The data in Figure 6.4 indicate that the junior high, technical high and the upgraded high school teachers seemed to be more dependent upon using science textbooks than their counterparts in the private high and traditional high schools. The majority of junior high, upgraded high and technical high school teachers reported that they use used their science textbooks at least once per lesson, whereas the majority of private and traditional high school teachers responded that they use them once per week or at least once every few weeks. The teachers' qualitative comments revealed two specific reasons for this textbook dependency.

First, the teachers in the private and traditional high schools have more resources and are better qualified than those in the other types of schools. These teachers argued that the science textbook provided limited opportunities for active learning and had developed their own supplementary materials as a result of which, the need for science textbooks gradually decreased. Second, the junior high, technical high and upgraded high schools are less well-resourced and pedagogy is driven by the traditional chalk-and-talk method of instruction; science teachers are less confident about their own teaching skills and are often ill-equipped to facilitate learning (Evans, 2001; Soyibo, 1998). In such circumstances, these teachers rely heavily on the use of science textbooks. In addition, the limited supplementary materials or access to these materials may also be contributing factors to textbook dependency in these schools. However, because the sample size is rather small the results should be cautiously interpreted; significantly more data would be required before making firm generalisations about the impact of the 'school type' on the teacher use of science textbooks.



**Figure 6.4** Frequency of how often teachers use their science textbook by school type

The literature suggests that teacher demographics such as gender, school type and years of experience influence the classroom practice of individual teachers (Nisbet et al, 2000). To investigate the relationship between teacher demographic and textbook use, a series of chi-square tests were conducted. The results of the chi-square tests for gender ( $\chi^2 = 0.328$ , 1 df,  $p > 0.05$ ) and school type ( $\chi^2 = 0.758$ , 1 df,  $p > 0.05$ ) showed no significant associations, so in this study it seems that the teachers' gender and the type of schools in which they teach do not significantly influence teachers' decisions to use student textbooks in science. In addition, a Pearson product-moment correlation coefficient was calculated to evaluate the relationship between the frequency of the use of the textbooks and the teachers' experience ( $n = 54$ ). Pearson's test shows that there was a strong positive association between the frequency of the use of textbooks and the teacher's experience ( $r(54) = -0.744$ ,  $p < 0.01$ ). It appears that the more experienced a teacher is the less reliant they are on the textbook. As with the findings related to the frequency of textbook use discussed earlier, there is an indication that science teachers' years of experience and textbook usage were consistent with the findings of previous research (Nisbet et al, 2000).

#### **6.6 Ways in which teachers use the science textbook**

The respondents were asked to select from among five options related to how they normally use the science textbook. The list provided the following options: background reading in advanced of lesson; making notes; using the answers to questions at the back of the textbook for correcting students work; as a source of diagrams to copy on the board and; in other ways. Data for these results are presented as Table 6.3. Notably, all the respondents chose more than one option from the list, which would suggest that the teachers use the textbook in multiple ways to augment their teaching. It is also worthwhile to note that none of the respondents chose 'in other ways', this may have been because the respondents were satisfied that the options covered all the ways in which they used the textbook. For this reason, 'in other ways' was excluded from the results table.

**Table 6.3 Ways in which teachers use the science textbook**

How teachers normally use the textbook	Responses		Percent of Cases
	N	Percent	
Background reading	53	33%	98%
Making notes	36	23%	67%
Using the answers to questions at the back of the textbook for correcting student work	31	20%	57%
As a source of diagrams to copy on the board	39	25%	72%
<b>Total</b>	<b>159</b>	<b>100%</b>	

The data displayed in Table 6.3 show that the most popular response chosen by 98% of the respondents was ‘background reading that you do in advance of the lesson’. This accounted for 33% of all responses. These results are also congruous with the comments of the interviewed teachers in each of the five schools investigated in the study (see Chapter 7). Thus, it would seem that for most teachers the textbook is a source of reference to supplement science discourse and teachers’ subject narrative.

The data in the Table 6.3 also indicate that ‘making notes’ and ‘as a source of diagrams’ were also frequent ways in which teachers used the textbook. These responses were chosen by 67% and 72% of the respondents respectively. In addition, 57% of the teachers relied on the textbook to answer questions provided at the end of the textbook chapter. These results would suggest that teachers consider the textbook as an authoritative source of the expected science content knowledge (Kline, 2013) and are in accordant with the findings from the teacher interviews.

### **6.7 Introduction of materials from the textbook**

The pedagogical purposes for which the textbook was used was studied by analysis of responses to the question “How do you introduce material from the textbook to your class when you use it?” Responses choices included: discuss it with them; pick out keywords; notetaking; brainstorming and; summarising activities. These data are presented in Table 6.4.

It should be noted that the majority of respondents ticked more than one box, which would suggest that for teachers the textbook serve more than one pedagogic purpose.

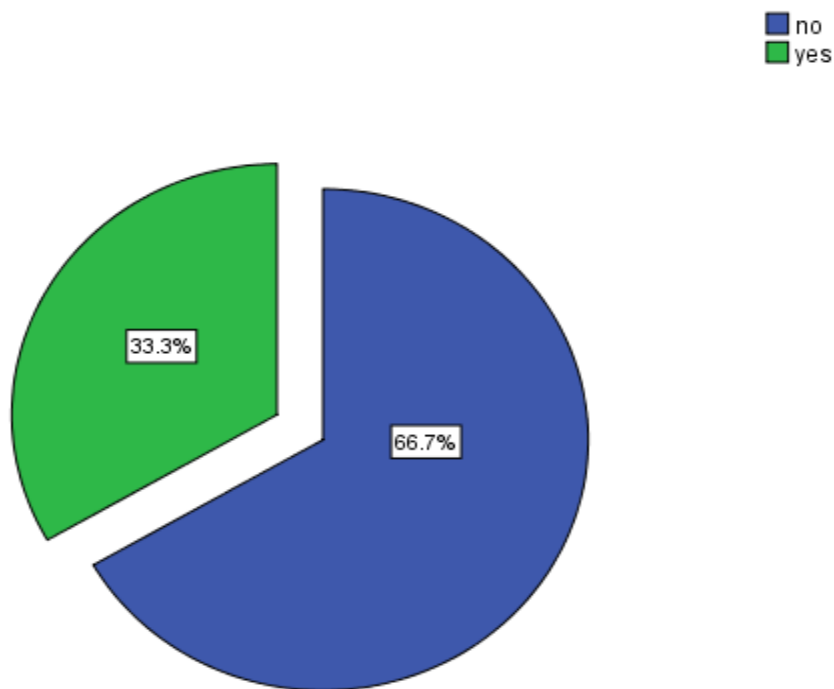
**Table 6.4 Ways in which teachers introduce material from the textbook**

Introduction of material from textbooks		Responses		Percent of Cases
		N	Percent	
	Note taking	34	30%	64%
	Brainstorming	32	28%	60%
	Picking out keywords	30	26%	57%
	Discuss it with them	10	8%	19%
	Summarising activities	8	7%	15%
<b>Total</b>		<b>114</b>	<b>100%</b>	<b>215%</b>

The data show note taking and brainstorming were the two prevalent ways of introducing material from the textbook. These were chosen by 64% and 60% of the respondents respectively. Such approaches are reflective of the passive, didactic and teacher centred approach highlighted by Soyibo (1998). These results also support my own observations in the classes I visited. In these classes, the students were frequently started with a brainstorming of the key ideas and then they instructed to copy text or diagrams from the chalkboard.

### **6.8 Teachers' perceptions regarding the ease/difficulty of science textbooks**

Item 14 on the teacher questionnaire was designed to gauge teachers' perceptions of the extent to which science textbooks are easy or difficult to understand by their students. Respondents were asked to answer 'yes' or 'no' to the question "Do you think science textbooks are easily understood by your students?". Data related to the teachers' responses are presented as Figure 6.5.

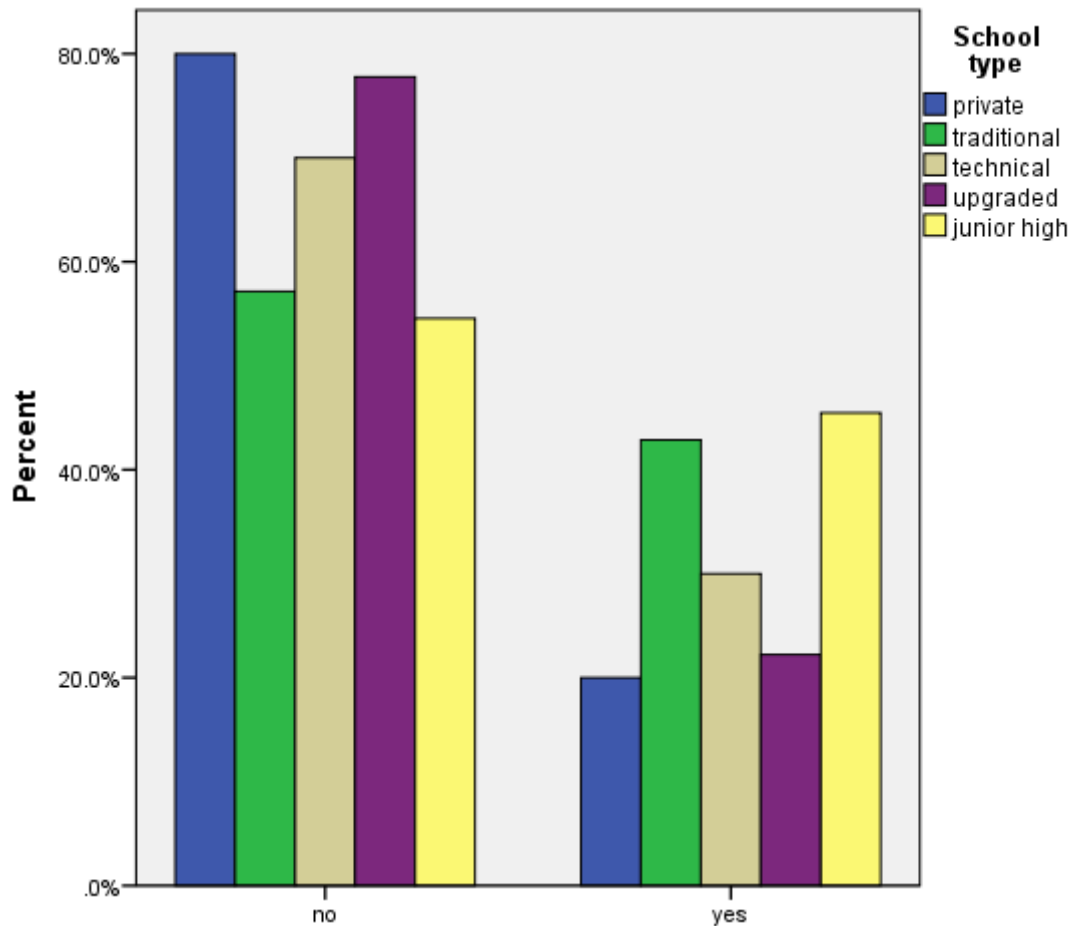


**Figure 6.5 Teachers' perceptions regarding the ease/difficulty of science textbooks**

As can be seen from Figure 6.5, an overwhelming majority of the respondent (69%) deemed the science textbook to be difficult for the learners. These results support the findings of many investigations of the reading difficulty of science textbooks. Notable among these studies are those carried out by Budiansky (2001) and Groves (2016). These researches have shown that many classroom teachers use textbooks that are too difficult for their students. The data was further broken down by school type to enable the investigation of differences, if any, of teachers' perception of the ease/difficulty of science textbooks among the five schools involved in the study (Figure 6.6). The data show that a considerably greater percentage of teachers in the junior high and upgraded high school regarded science textbooks as difficult for learners when compared to their counterparts in the private high, technical high and traditional high school. In respect of these findings, the data regarding the technical high school was somewhat surprising, since majority of teachers from this school reported high approval of the textbook. Moreover, evidence from the student questionnaires indicates that the students themselves judged science textbooks as very difficult to understand. Thus, it might be reasonable to infer that teachers' approval of the textbook is not an indicator of how well they think their students can comprehend it.

The findings regarding the junior high and upgraded high school teacher's perception about the extent to which science textbooks are difficult for their students is similar to the findings

from the analysis of the student’s questionnaire response in the reported in the final part of this chapter and the findings from the Cloze data analysis reported in Chapter 4. These data provide further support for the need for differentiated science textbooks that respond to the needs of all learners.



**Figure 6.6 Teachers’ perceptions on the extent to which science textbooks are easy/difficult to understand and school type**

### 6.9 Language used by teachers in various situations

To explore teachers’ language use inside and outside the classroom respondents were asked to indicate the language they used in various situations. As was with the case with the student questionnaires, teachers were asked to choose from a list of five options: always JSE; mainly JSE; always JC; mainly JC; and equal amounts of JSE and JC. Data are presented in Table 6.5.

**Table 6.5 Language used by teachers in various situations**

Items	Always JSE %	Mainly JSE %	Always JC %	Mainly JC %	Equal amount of JSE and JC %
Talking to students during lessons	5	90	2	1	2
Talking to colleagues	40	60	0	0	0
Talking to family members	20	5	70	5	0
Talking to friends outside of school	20	5	65	5	5
When disciplining your students	5	20	10	60	5

As Table 6.5 shows, on average 90% of the teachers who took part in the study reported that they mainly used JSE when talking to students during science lessons. These results are not surprising since JSE is the official language of the island and the language of instruction in the classroom. Hence, all teachers are expected to use it when interacting with their students. However, such a situation raises serious questions concerning the extent to which these lessons are accessible to the students, since, as discussed in chapter one, only a minority of Jamaican students can claim competence in JSE. As a consequence, a problematic classroom situation evolved for Creole-speaking students, learning science in JSE.

In respect of the data concerning the language used when talking to friend and family the results support Simmons-McDonald (2006) assertion that JC is the language of choice for social context. On average, 70% and 65% of teachers reported that they always spoke JC when talking to their friends and intimates, respectively. Interestingly, 20% of the teachers indicated that they always spoke JSE when they spoke to friends and family. As was the case with the students, these teachers were more prominent in the private high and the traditional high school. Such data support many of the findings from socio-linguistics studies highlighted clear links between language and social class (see, for example, Craig, 2006; Patrick, 2009; Rickford & Rickford, 2010).



## **6.10 Student questionnaire data analysis**

The student questionnaire was organised into four parts. The first part included identifiers and a question about the respondent's gender. The next part comprised open-ended questions inviting extended responses from students about their liking for and attitudes towards their science textbook. The students were asked to identify the sections of their textbook which they found helpful and those sections which they found difficult. They were also asked to suggest how the textbook could be improved. The third part of the questionnaire consisted of three multiple choice questions concerning the frequency of use, and how and when they used their science textbook. The final part of the questionnaire was concerned with the language respondents used in various situations.

The information contained in the questionnaire was coded and analysed using the computer software, Statistical Package for the Social Science (SPSS). The survey responses were followed by focus group interviews involving six participants in four of the five participating school. The focus group interviews questions were similar to those used on the questionnaire. In this way, triangulation of data from the questionnaires and the focus group interviews facilitated the validation and consistency of the research findings. This helped provide a more enriched and balanced account of the respondents' attitudes towards and judgement of their school science textbook. This form of data collection is supported by researchers such as Creswell (2014).

### *6.10.1 Demographic profile of the respondents*

Data related to the distribution of the respondent by school type are presented in Table 6.6. As can be seen, a greater number of the respondents were enrolled in the technical high, traditional high and the upgraded high schools than the private high and the junior high schools. The data is also broken down by gender to facilitate the investigation of differences between boy' and girls' judgement of the science textbook. Data related to the respondent's gender are shown in Table 6.7. There were slightly more females than males in the study. This is representative of the schools' population.

**Table 6.6 Distribution of the respondents among school types**

SCHOOL TYPE	DISTRIBUTION OF RESPONDENTS	
	Frequency	Percent
Junior High	49	11
Private High	50	11
Technical High	138	30
Traditional High	107	22
Upgraded High	128	28
<b>Total</b>	<b>465</b>	<b>100</b>

**Table 6.7 Distribution of the respondents by gender**

GENDER	DISTRIBUTION OF RESPONDENTS	
	Frequency	Percent
Male	205	44
Female	260	56
<b>Total</b>	<b>465</b>	<b>100</b>

### 6.11 Students' perceptions of their science textbook

In the student questionnaires, the students were asked to indicate their opinions of the science textbook. As suggested by Kearsey (1997), students' liking for, or dislike of, a textbook can be a general indication of accessibility. Data concerning students' perceptions of the science textbook studied were obtained through their responses to the question "Do you like using your science textbook?" The responses were coded as follows:

- those students who like using the textbook
- those who dislike using the textbook
- those who left the space blank.

Overall, 51% (n = 237) of the 465 students who responded to the questionnaires stated that they like using the science textbook, 45% (n = 209) disliked it and only 4% (n = 19) did not respond. In Table 6.8, these data are presented by school type. The results show high approval of the textbook in the private school (74%) and the traditional high school (64%) compared with low approvals in the junior high school (38%) and the upgraded high school (42%), with the technical school lying in between (47%). There are two reasonable explanations for these

findings. First, it is possible that Jamaican private and traditional high schools usually enrol the more academically able students (who obtain the highest scores in the Grade Six Achievement Test (GSAT)) compared to the junior high, technical high and upgraded high schools (which enrol mainly students who receive low scores or have failed the GSAT); secondly, private and traditional high schools enjoy the services of experienced university-trained graduate teachers than do the other school types investigated in the study (Evans, 2001). Such teachers are more likely to provide the academic motivation and stimulation that could facilitate the development of their students' reading skills and hence the students are more likely to approve of their science textbook. Interestingly, these findings are contrary to that reported by the teacher questionnaire respondents. There was a high disapproval of the textbook by the teachers in both the private and traditional high school (see Figure 6.4).

**Table 6.8 Student approval of science textbooks by school type**

			Student Approval of Science Textbooks		
			Students who liked the textbooks	Students who disliked the textbook	Students who left the space blank
<b>SCHOOL TYPE</b>	Junior High	Count	17	24	4
		% within School Type	38%	53%	9%
	Upgraded	Count	54	76	0
		% within School Type	42%	59%	0%
	Technical	Count	66	63	11
		% within School Type	47%	45%	8%
	Traditional	Count	64	36	1
		% within School Type	63%	36%	1%
	Private	Count	36	10	3
		% within School Type	74%	20%	6%
	<b>Total</b>	<b>Count</b>	<b>237</b>	<b>209</b>	<b>19</b>
		<b>% within School Type</b>	<b>51%</b>	<b>45%</b>	<b>4%</b>

### 6.12 Gender and students' approval of the science textbook

As outlined in Chapter 1, gender is not just an important classroom context issue in this research but is also one of the power hierarchies around which the school curriculum is organised and, therefore, should be an important consideration when assessing the

accessibility of science textbook in the Jamaican context. Although gender has been used extensively as a variable for investigating a number of phenomena in the Jamaican education system, there is a dearth of studies which have examined issues affecting the equity of science education for boys and girls. However, several international studies have analysed and reported on how gender inequity is created in science textbooks through the curriculum (Elgar, 2004; Gates, 2014; Miller et al, 2015; Potter & Rosser, 1992; Zittleman & Sadler, 2002). Many of the issues raised in these studies concerning gender and textbook are relevant for Jamaica, since curricula, pedagogy and science classroom resources remain gender-biased to a large degree, and are rarely sympathetic to the distinctive needs of females (Bailey, 2002). Moreover, research findings also suggest a general link between gender and students' attitude and perception of school science textbooks (Baker, 2016; Jones et al, 2000). Therefore, it is instructive to consider the extent to which students' approval of the textbook is linked to their gender.

The data in Table 6.9 show that a considerably greater percentage of boys (60%) than girls (44%) approved of the textbook. To establish if there were any significant relationships between the students' gender and whether or not they approve of their science textbook a Chi-square test of independence was undertaken. The results revealed that there was no statistically significant relationship between the variables ( $\chi^2 = 0.34$ , 1 df,  $p > 0.05$ ).

**Table 6.9 Gender and students' approval of their science textbook**

			Students Approval of Science Textbooks		
			<i>those students who liked the textbooks</i>	<i>those students who disliked the textbook</i>	<i>those who left the space blank</i>
<b>GENDER</b>	<b>Male</b>	Count	123	72	10
		% within Gender	60%	35%	5%
	<b>Female</b>	Count	114	137	9
		% within Gender	44%	53%	4%

The analysis also revealed large variations in students' approval of their science textbook as a function of their gender and school type (see Table 6.10). The results show that there was a higher approval rate of the textbooks for male students compared with their female counterpart in each of the five schools investigated in this study. In addition to confirming these expected results, other interesting information is presented by Table 6.10. Significantly,

the data showed a particularly low approval by the female students in the junior high (30%) and the upgraded high school (30%). This pattern of response may be indicative of the fact that girls in the junior high and upgraded high schools are predominantly from lower socio-economic backgrounds where negative attitudes towards reading still exist (Buckingham et al, 2014).

**Table 6.10 Students’ approval of their science textbook as a function of their gender and school type**

SCHOOL TYPE	GENDER	Approval of the Science Textbook		
		Students who like the science textbook	Students who dislike the science textbook	Students who left the space blank
Junior High	Male	46%	41%	14%
	Female	30%	65%	4%
Private High	Male	74%	26%	0%
	Female	73%	15%	12%
Technical High	Male	52%	38%	10%
	Female	44%	50%	6%
Traditional High	Male	82%	15%	3%
	Female	52%	48%	0%
Upgraded High	Male	54%	46%	0%
	Female	30%	70%	0%

### 6.13 Students’ opinions on why they like or dislike their textbooks

As a follow-up to the question “Do you like your science textbook?”, question 2 required students to explain why they liked or disliked their science textbook. This question was open-ended, with space provided for responses, and was designed to provide participants with the opportunity to express their personal feelings, attitudes and beliefs regarding their textbook. In supporting the use of open-ended responses in survey analyse, prominent scholars such as

Roberts et al (2014) argue that the use of open-ended questions allows one to probe for a better understanding of the respondent's own thoughts. However, Creswell (2014) cautioned that a non-response to an open-ended question may stem from ineloquence. In other words, participants may not respond because they lack the necessary rhetorical devices. Furthermore, being qualitative in nature, open-ended questions are more difficult to analyse than their closed counterparts. Nevertheless, while such pragmatic concerns are reasonable, in the context of this research it is salient to consider the extent to which the science textbook is accessible from the students' perspectives.

In addition, this analysis also employed a general inductive approach as articulated by Thomas (2006). The central function of such an approach is "to allow research findings to emerge from the frequent, dominant, or significant themes inherent in raw data" (Thomas, 2006, p. 238). In this sense, the analysis is consistent with the general patterns of 'grounded theory' as articulated by Glaser and Struass (1967), in which the central themes are developed in the actual data collected.

The questionnaire responses were analysed following the thematic analysis outlined by Braun and Clarke (2006). The students' responses were rigorously and systematically read to identify emerging themes that appeared to be important or relevant to the context of the research. Coding categories were then developed from the different themes that emerged during this process. The relationships between developing themes were given careful consideration. In this way, I was also able to identify patterns that required further probing. As new codes developed, the coding frame was re-examined and the questionnaires were re-read according to the new composition and structure. This formulation was used to create categories, which were then theorised into broad themes after further contemplation. This was felt to be less subject to bias than attempting to collate the responses in note form. Towards the conclusion of the process no new themes arose, which indicated that the most important themes had been identified.

The coded responses for each student were entered for statistical analysis. These qualitative items were analysed according to the coding scheme provided in Table 6.11. This coding scheme was used to categorise 597 student comments (some students produced more than one comment). For analytical purposes, the comments made by the respondents, both favourable and unfavourable, were independently assessed by two raters (myself and a peer)

and ranked from very positive to very negative. During the deliberation process, for the most part, there was broad inter-observer agreement. However, in a few cases where there were discrepancies, the comments were discussed and a consensus position reached. The percentage of agreement for categories and ratings values were 95% and 90% respectively.

**Table 6.11 Coding scheme to categorize student comments about their science textbook**

<b>CATEGORIES</b>	<b>CRITERIA</b>
<b>Physical Aspects</b>	
Layout	The arrangement of the visual elements on a page of the science textbook. Basically, whether the layout is easy to follow or not.
Typography	The style, arrangement and appearance of the printed material on a page.
Attractiveness	The visual appeal and desirability the textbook to the reader, including cover pages.
<b>Teaching and Learning Aids</b>	
Questions and answers	The summary or practice questions presented at the end of each unit.
Visual representations	Refers to comments about the visual symbols used in the textbook (e.g., graphs, diagrams, illustrations, pictures).
<b>Linguistics and Communication Features</b>	
Vocabulary and terminologies	Respondents makes a comment on the extent to which the scientific words are suitable for their age level.
Language	Refers to the ease/difficulty of the language usage in the textbook.
<b>Interest and Motivation</b>	
Enjoyment and Interest	Student refers to the textbook as being or not being fun/enjoyable/engaging/interesting.
<b>Content Selection and Presentation</b>	
Coverage of course topics	Student comments on whether or not there is sufficient coverage of course content.
Presentation of content	Student comments on whether or not the material is clearly presented.
<b>Understanding and Explanation</b>	
Challenge	Refers to the ease/difficulty of the concepts covered in the science textbook. In other words, whether or not the content level matches the student's cognitive level.
Reading level	Refers to whether or not the student finds the textbook difficult to read.
<b>Other</b>	
Other	Any student comment that does not fit in any of the above categories.

The categories were then mapped into numeric values from +2 to -2 using a Likert-type 5-point scale with +2 rated as very positive, the neutral point (0) being neither positive nor negative and -2 rated as very negative. Table 6.12 presents examples of comments scored at

each point. The numerical presentation and the quantitative analysis of the frequencies of occurrence in each of the categories of interest were complemented with illustrative and verbatim quotations from students' written answers.

**Table 6.12 Comments and numeric values**

COMMENTS	Very positive	Positive	Neutral	Negative	Very negative
	+2	+1	0	-1	-2
I enjoy reading my textbook because it has beautiful and helpful pictures and diagrams	✓				
Because it gives us information		✓			
I find the diagrams helpful but some of the topics are difficult to understand			✓		
Because sometimes I can hardly find anything about the topic I am doing in class in it				✓	
I hate my textbook because it is boring and difficult to understand					✓

As outlined above, the comments about the textbook were reviewed and coded by using the themes that recurred in the data. This approach was preferred to using preconceived themes or categories from the research literature. An important consideration of this study is to flesh out the extent to which the textbooks are accessible from the viewpoint of the students. Therefore, it was important that the categories emerged from the data. Through this process, eleven broad categories were derived from the data: questions and answers; page layout, typography and attractiveness; coverage of course topics; presentation of content; visual representations; vocabulary and terminologies; language; enjoyment and interest; challenge; reading level; and others.

The eleven categories were further aggregated into six 'super categories'. Challenge and reading levels are concerned with the reader's 'understanding and explanation' of the textbook. Page layout and typography deal with the 'physical aspects' of the textbook. Questions and answers and visual representation with the 'teaching and learning aids'. Vocabulary, language and terminologies are concerned with the 'linguistics and communication features' of the text. Coverage of course topics and presentation of content involves the 'content selection and presentation' of the textbook. Enjoyment and interest



covers the ‘interest and motivation’ of the reader. The category ‘Other’ included responses that did not fit in the existing labels, for example “there are not enough books for all the students so I didn’t get one” or “It is too heavy and really hard to carry in my school bag”. The assignment of categories to ‘super categories’ and the total number of responses and percentage for each category is presented in Table 6.13.

**Table 6.13 The grouping of data categories**

<b>SUPER CATEGORIES</b>	<b>DATA GROUPING</b>	<b>TOTAL NUMBER OF RESPONSES (n)</b>	<b>%</b>
Physical Aspects	Page layout; typography and attractiveness	29	5
Teaching and Learning Aids	Questions and answers; visual representation	205	34
Linguistics and Communication Features	Vocabulary and terminologies; language	83	14
Interest and Motivation	Enjoyment and interest	10	2
Content Selection and Presentation	Coverage of course topics; presentation of content	75	13
Understanding and explanation	Challenge; reading level	175	29
Other	Other	20	3

Table 6.14 presents results for the super categories and the percentage of students who made positive, neutral and negative comments within each data grouping. Data sets for the super categories are discussed below.

**Table 6.14 Summary of student comments about their science textbook**

Super categories	Data grouping	Total number of responses	Mean	Standard deviation	% of students who made negative comments	% of students who made neutral comments	% of students who made positive comments
Physical aspects	Layout	13	0.50	0.91	56	35	9
	Typography	7	0.90	0.44	9	60	31
	Attractiveness	9	1.00	0.00	19	54	28
Teaching and learning aids	Questions and answers	39	0.71	0.76	54	30	16
	Visual representation	166	1.00	0.00	9	31	60
Linguistics and communication features of the textbook	Vocabulary and terminologies	43	-1.19	0.40	59	21	20
	Language	12	-0.14	1.25	66	16	18
Interest and motivation	Enjoyment and Interest	10	-0.04	1.18	80	13	7
Content selection and presentation	Coverage of course topics	61	1.00	0.00	18	17	65
	Presentation of content	14	-0.37	1.11	47	37	16
Understanding and explanation	Challenge	123	-0.46	1.02	55	20	25
	Reading level	52	-0.88	0.86	60	36	4
Other	Other	20	-0.14	1.25	68	24	8

### 6.13.1 Physical aspects

Table 6.14 shows that the most positive comments in the ‘physical aspect’ category were made with reference to the visual attractiveness (28%) and typography (31%) of the textbook. This may suggest that despite some problems, the respondents were satisfied with these aspects of the textbooks. Some of the favourable comments made with respect to the typography and visual attractiveness were: “the cover is colourful and attractive” (student 41), “the pages are colourful and engaging” (student 62) and “the pictures are cool and useful they make reading the textbook more interesting” (student 43). Conversely, some students expressed the view that “the print is too small” (student 431), “the pages are not colourful

and very interesting it's a turn off" (student 131) and "it needs to have less writing and more pictures" (student 78).

With respect to the page layout, results from this study seem to indicate that students appear to be less than satisfied. Only 9% of the students made a positive comment in terms of the page layout, while the majority, 56%, were not happy with this aspect of the textbook. Comments about the page layout of the textbook were quite varied from very negative to very positive. For instance, Student 120 indicated that he was happy with the textbook because the page layout "is easy to follow". Student 17 noted that: "the topics I need to revise are nicely organised, I don't need to use the syllabus". Relatedly, Student 56 commented that: "Each topic is always followed by practise questions so it helps me when I revise for a test".

Discontentment about the page layout in the textbook was also commonplace. Student 213 put it like this: "The textbook sucks most pages are full of text I hate to read all that text at once". Student 88 echoed similar sentiments: "Too much writing and not enough diagrams and pictures. I lose interest in a very short time". Student 24 said she did not like her science textbook because "the page too mix up the words and pictures just confuse me", while student 19 noted: "To be honest I find most of the textbook interesting and helpful but sometimes I can't understand the topic because of how the print too fine". These findings corroborate the findings of Walpole (1998) and Yildirim (2006).

### *6.13.2 Teaching and learning aids*

As outlined in Section 1.3, visual representations play an important role in communication of science concepts. Indeed, the number and diversity of visual representation found in science textbooks speaks directly to the importance of visuals in making science more accessible to students. Although most of the current science education literature has focussed on understanding the impact visual representations have on students and their learning (Pozzer-Ardenghi & Roth, 2005), very few studies have focussed on the judgments that students hold about the visual aids in their textbooks (Yildirim, 2006). In the context of this study, the role and the impact of visual representations on the reader were given careful consideration because many of the teachers interviewed suggested that some of their students depended heavily on visual aids for understanding written text. Furthermore, 27% of the students' comments referred to the use of visual representations as tools for increasing understanding

and comprehension of scientific concepts. These findings would suggest that from the students' perspective diagrams are critically important in conveying scientific information.

As Table 6.14 displays, the most frequent comments that were made by the students were in the visual representation category. These results may indicate that there is a particularly strong belief held by the students in this study in regard to the value of visual aids in learning scientific principles and concepts. The data also revealed that 60% of the students made positive comments about the visual representations in the textbook, with fewer than 10% making negative comments. Among the visual representations, the use of diagrams appears to be the most frequently mentioned by both students and teachers. Of the 166 comments in this category 126 referred to the use of diagrams.

As in the case with the students' comments on the physical aspects of their textbook, these comments also ranged from very negative to very positive. For example, student 8 liked the text book because it "has beautiful pictures" and student 112 thought the "pictures are interesting". In similar vein, student 87 liked the textbook because the "illustrations given are colourful and big in size this make the book more interesting to read". These students' views are supported by researchers such as Yadav (2007) who argues that textbook illustrations should be colourful and as large as possible as they attract more fascination and appreciation from the reader.

Some students also commented that the visual representations in the text book pique their interest in science. For instances, student 35 noted: "I like to run through it [textbook] and look at the pictures and sometimes this makes me want to learn more about the topic". A similar view was expressed by a student from a traditional high school (14): "The diagrams and pictures make the content more interesting and this makes me want to read more about a topic". Such data are supportive of the findings by studies done by Stockwell et al, 2015 and Harp and Mayer (1997) who reported that a textbook lesson may be made more engaging by stimulating the interest of the reader by adding illustrations. This approach, they argued, increases the reader's general level of arousal and heightens their curiosity and interest in the topic; they further highlighted the use of diagrams and illustrations as fruitful tools in increasing the interest of a scientific explanation.

Interestingly, while most of the responses were quite positive about the use of illustrations in the textbook, some of the respondents were less than satisfied. Some complained that the

textbook was not “illustrative enough”. Other respondents felt the diagrams and illustrations could have been made more self-explanatory and simpler. In the words of one respondent (204): “I would have preferred if the illustrations were in the form of cartoons and comic figures”. In support of these findings one teacher commented that in her view the illustrations were not labelled properly and required better explanation and elaboration in the text.

Conversely, some respondents thought that the quality of the diagrams in particular was inadequate and that the diagrams had been poorly selected. Further, some of the visuals were considered not appropriate to the content and in some cases, there was weak connectivity between the diagrams and the content. Further comments highlighted the difficulties students were having in the interpretation of diagrams used in the textbook. This was captured by student 90: “I find the diagrams very confusing and difficult to understand”. These comments resonate with the findings of Cromley et al (2010) and Pozzer and Roth (2003). These authors have consistently argued that the interpretation of diagrams may be a demanding task for students because of the different domain knowledge and convention rules used in the diagrams.

In contrast to the findings for the visual representations, students were less than positive about the use of questions and answers in the textbook. The majority (54%) of the students made negative comments, 30% made neutral comments and 16% made positive comments. All the comments, both negative and positive, were related to the summary test questions at the end of the chapters. For example, in the words of respondent 33, “The questions help me to review what I have read”, and another (46), “My teacher uses similar types of questions in the exams, so I find it helpful to go over these questions before the exams”. However, one student (20) lamented that: “Some of the test questions do not match themes outlined in the book” while another one (51) complained that: “the test questions were unclear and usual need my teacher to explain them to me before I can understand them”.

### *6.13.3 Interest and motivation*

The interest and motivation of the students to read and engage with the science textbook might be considered a general indicator of accessibility and, therefore, of importance to this research. Indeed, the argument put forward in Chapter 3 provided a link between motivation, interest and textbook comprehension. It was argued that students who perceive the text to be easy to comprehend may likely to find it more interesting than those who perceive it to be

difficult. Similarly, the greater an individual's interest with the text, the greater their comprehension.

As the data in Table 6.14 indicate, 80% of respondents who made a comment under the category 'Interest and motivation' were less than satisfied that the textbook was interesting and enjoyable to read. Fewer than 10% of the respondents commented that the book was interesting and motivated their interest in science and 13% made a neutral comment. These findings are alarming if one accepts the argument put forward in Chapter 3 that students who consistently read for their own interest are more likely to interact with text more deeply and gain relatively high amounts of scientific knowledge or aesthetic experience (Owolabi et al, 2014).

These results suggest that interest and motivation have some impact on the students' ability to read and comprehend their science textbook. Indeed, some of the respondents mentioned that because they did not like science they had problems in understanding the text. For instance, student 207 wrote "I find science dull and boring so I hate reading the textbook. I only read it to pass my test". A similar view was expressed by another student (301): "Science is not an important subject for me so I have little interest in reading the textbook ... the meanings of scientific terms are too long to remember". This also consolidates what teachers said about the students' motivation and the textbook accessibility. The teachers reported that some students were slow in reading and learning new scientific concepts and vocabulary and that they had difficulties with themes and topics dealt with in the textbook, which they did not consider to be interesting (see Chapter 7).

It is worth pointing out that all the positive comments about the textbook was made by participants attending the private and traditional high schools. As previously discussed, these are schools that are more likely to be attended by students from wealthier economic backgrounds. Thus, taking all of these results together, it seems plausible to infer that students who found the science textbook interesting and enjoyable were more likely to come from families with a high socio-economic background. In this, the findings indirectly support the conclusions reached by the National Assessment of Education Progress (NAEP) which reported that compared to children of higher socio-economic background, children of low income families are less motivated to read and are significantly behind in their reading levels (NAEP, 2004).

It is, however, important to point out that serious questions have been raised about conclusions that have resulted from the use of socio-economic background in past research (see, for example, White, 1982). White warns that the use of socio-economic background has become axiomatic to social scientists and as a consequence the influence of some other background and school factors are sometimes overlooked. Indeed, even though in the context of this research, socio-economic background may have a strong relationship with motivation and the comprehension of the textbook, it is also plausible that other variables, such as parental expectation and beliefs, may influence a child's motivation to read science textbooks. A definitive answer to the issues raised above was beyond the scope of this study, but these are issues that deserve further research.

#### *6.13.4 Linguistics and communication features of the textbook*

Many of the studies reviewed in Chapter 3 have shown that the linguistics and communication features of science textbooks exceed the normal experience of many secondary school students for whom they are written (see, for example, Fang, 2006; Wellington & Osborne, 2001). Furthermore, some of these studies have focussed attention on science learners for whom English is a second language and the findings indicate that understanding textbook language is likely to be more difficult for students who learn science in a second language (see, for example, Miller, 2009; Rollnick, 2000). These studies discuss many of the issues as they relate to the learning of science through a second language in various international contexts, and the findings have application to the situation in Jamaica.

Young (2005) argues that vocabulary is the essential element of comprehending scientific concepts. A number of research studies have consistently pointed to students experiencing significant lexis-related difficulties in the interpretation and understanding of domain-specific vocabulary in science text (Osborne, 2014; Rector, Nehm & Pearl, 2013). These studies also indicate that even students whose first language is English and are learning science in English experience difficulties in dealing with specialist vocabulary and in coping with the language demands and assumptions made by science teachers and writers of curriculum materials (Henderson & Wellington, 1998). This being the case, the problems face by bilingual and bi-dialectal societies such as Jamaica in learning science from textbooks are likely to be even greater and more complex.

Within this context, the students' perception of the linguistics and communication features of their science textbook is of interest to this research since, as discussed in Chapter 1, JC is the first language for many Jamaican students whereas textbooks are written in JSE. Such a situation poses severe obstacles to comprehension of the text when the students have to learn new concepts in a language in which they are not very proficient. Moreover, during formal and informal conversations, some teachers perceived language to be the main barrier for learning science rather than the science content itself. Thus, an important question in the context of this research is: To what extent do Jamaican science students perceive their science textbook as accessible in terms of its linguistics and communication features?

As evidenced by Table 6.14 above, the most frequent comments in the 'linguistics and communication features' category were based on issues related to the vocabulary and terminology aspects of the textbook. Of the total number of responses concerning the vocabulary (n = 71), 59% were unfavourable, 21% were considered neutral and 20% were favourable. The majority of the negative responses (58%) indicated a general dissatisfaction with the vocabulary load and excessive use of new terminology in the science textbook. Respondents felt that the textbook "contained too many unfamiliar words" and was too detailed or "too heavy on the use of science terms". Some of them commented that they did not understand the "wording" of the textbook and wished the authors could use "smaller words" to describe scientific terms. For example, in the words of student 37: "I like my science textbook but it contains too many words that are difficult to understand". A similar view was expressed by student 58 who wrote: "I use my textbook mainly for homework but most times I struggle to make sense of what I am reading because it has too many strange words".

To this extent, the data endorse the position of Yager (1983) and Groves (1995, 2016) who reported that the number of new science terms presented in the most widely used science textbooks in the USA were much higher than that recommended secondary school modern foreign language courses. The data are also indirectly supported by Yager et al (2009) who opined that while textbooks include basic information about science subjects, they typically over-emphasise vocabulary and factual information. These findings further confirm the results from the Cloze test and Fry readability graph discussed earlier.



### 6.13.5 *Content selection and presentation*

The data in Table 6.14 indicate that on average the respondents were satisfied with the textbook with respect to content selection and presentation. Of the 61 comments made in the 'coverage of course' category, 60% said that the textbook provided sufficient coverage of course topics. Fewer than 20% were negative while 18% were neutral. These findings are consistent with the teachers' perceptions of this aspect of the textbook, albeit some of the teachers from the junior high and upgraded high schools commented that the content was far too detailed for their students.

With respect to the presentation of content, the data seem to indicate that the students were less satisfied. Fewer than 20% of the respondents commented that the topics were logically organised and the content presented clearly. Many the comments (47%) ranged from negative to very negative. For instance, some students felt that the textbook failed to use enough examples from the local context which would have been more familiar to the reader. Other respondents complained that the content was poorly sequenced and as a consequence it was difficult to see the connection between chapters and units. The students' views were also echoed by one teacher who wrote: "I don't think the way the chapters are set out is very good. They could be better organised. There could be a section at the back which could help the students with the questions without actually giving them the answers". This is an important observation as the poor sequencing of science textbook content is likely to create problems for students since they would find it difficult to establish links between science topics.

Some students were also critical of the unattractive way in which the content is presented. This was captured by student 76 who lamented: "the way the content is presented in the textbook is not attractive and its makes reading boring". In similar vein, student 34 thought the book was cluttered with "loads of information and take a long time to read". In support of such students' views, one teacher was extremely critical about the presentation style of the content, describing the use of large type chapter heading which resulted in hyphenation of words as "unattractive" and "problematic". This problem he suggested was also evident in the text. Several teachers also pointed to other examples of poor presentation including typographical errors and repetition of some sentences.

### 6.13.6 *Understanding and explanation*

Arguably, one of the most significant criteria for assessing science textbook accessibility deals with the students' understanding of the printed material. In other words, the subject narrative in the textbook must be appropriate for the students who are expected to use it. The research studies reviewed in Chapter 2 have highlighted many of the reading challenges that science students encounter in accessing textbooks (see, for example, Ayodele, 2013; Soyibo, 1998). In sum, these studies have reported that many of the textbooks used in school science are too advanced for the students for whom they are recommended. Consequently, in the Jamaican context, where textbooks are central to science pedagogy, it seems doubtful that the students will learn much science from them in a meaningful way.

The earlier analysis of the Cloze test data (see Chapter 4) provided empirical evidence that the textbook under investigation has a high readability level and thus exceeds the reading comprehension level of the students. Moreover, the Cloze data also suggested that many the students, especially in the junior high and upgraded high, were reading at the frustration level. In addition to these observations, many of the respondents on the teacher questionnaires consistently highlighted scientific concept difficulty as a major barrier to the accessibility of textbook by their students. Within this framework, it is necessary to explore the students' perception of textbook difficulty with regards to 'understanding and explanation'.

Table 6.14 identifies the total number of responses and the percentage of comments that were rated as positive, neutral and negative in the 'Understanding and explanation' category. The results indicate that 29% (n = 175) of the respondents' comments fell in this category. This may suggest that the extent to which the students can read and understand the scientific concepts and principles in the textbook is of importance to them. The data in Table 6.14 also reveal that the majority of the respondents (60%) perceived the textbook as unfavourable with respect to the reading level. Notably, fewer than 5% made a positive comment whilst 36% made comments that were categorised as neutral. Regarding the ease or difficulty of the concepts covered in the textbook (sub-category labelled 'challenge'), the data show that 55% perceived the textbook content as difficult and incomprehensible, with 25% of the respondents making a positive comment and 20% a neutral one.

The respondents' comments indicated that the science texts presented serious problems of comprehension and readability. One student (87) remarked, "Some of the topics are really difficult to understand. I think this is why I have done badly in my science test this year" and another (student 411) commented, "I do not like my textbook because I struggle to understand the passages. My teacher gives me homework and classwork from it and I usually can't do the work". Another student (55) stated, "I don't understand most of the topics in the book so I only use it when my teacher or my mum teaches me from it. Topics like Reproduction and Energy are really hard".

Some students complained that the readability of the science textbook far exceeds their reading age. For example, student 29 wrote, "I don't like the textbook, it was not clearly written for grade 7 students. The science in it is way too advanced for me". In similar vein, student 38 remarked "The textbook is too hard and I can't be bothered to read it ... surely they don't expect grade 7 students to remember those long definitions of the science terms". Such findings are not entirely surprising, since several studies have reported that school science textbooks were difficult for the target group of students to read and understand (e.g., Ayodele, 2012; Yong, 2010).

#### 6.13.7 *Other*

There were 20 comments made in the 'other' category, 68% of which were ranked as unfavourable, 8% favourable and 24% neutral. Many of the comments were vague or incomprehensible and, therefore, were difficult to categorise and analyse. However, they provided valuable insight into the respondents' attitudes towards science classroom discourse, science teachers and textbooks in general. For example, some students expressed that they disliked their science textbook because they "don't like science" or they "hate the way the science lessons are taught".

Some comments were related to other sensible issues such as the weight of the textbook. In particular, they complained that the textbook was too bulky and they hated carrying it around. Additional comments such as "the book is rubbish", "I can hardly find anything in it", "the cover is gone and pages are missing", "it is very educated" and "it is a source of understanding" were considered too vague and were not analysed further.

## **6.14 Students' judgments about selected features of the textbook studied**

The student questionnaire included three open-ended questions related to the respondents' perceptions about the sections of their science textbook that they found helpful, the sections they found difficult and improvements, if any, they would like to see made to the textbook. These open-ended survey responses provided the framework for gaining deeper insights into the respondents' thoughts on some of the underlying issues surrounding the accessibility of their science textbook. Students' judgment of these aspects of the textbook are considered to be important issues in its general accessibility and thus of interest to this research study.

### *6.14.1 Students' perceptions of the helpful or difficult sections of the textbook*

The statistics relating to the students' judgement about the sections of the textbook they found helpful or difficult were obtained from students' responses to the questions "Which sections of your science textbook do you find most helpful?" and "Which sections of your textbook do you have the most difficulty with?"

With regard to the sections the respondents found helpful the most frequent response in the junior high and the upgraded high schools was "none". The most common responses in the traditional high school were the suggested experiments included in each topic. This was an interesting observation, since the resources for these suggested experiments, according to some teachers' response on the questionnaire were not available to most Jamaican schools (see Section 6.4).

The most frequent responses regarding the sections of the textbook they found difficult were 'all'. Such comments were most prevalent in the junior high, technical high and upgraded high schools. These findings might indicate that the textbook is unsuitable for students with average and below average abilities and provide further evidence in support of the data from the Cloze test reported earlier in Chapter 4.

### *6.14.2 Students' suggested improvements to the textbook*

The open-ended survey data concerning responses linked to improvements to the textbook are presented in Table 6.16. These data were compiled from students' responses to the question "How do you think your science textbook could be improved?" A thematic text analysis method, similar to that described earlier (see section 6.13), was employed with few modifications. As previously outlined, such an approach is suited for responses generated by

open-ended questions because of its flexibility in discovering patterns and developing themes (Braun & Clarke, 2006). As was done previously in Section 6.13, the responses were read and re-read several times and the overarching themes that emerged were identified. Nine categories were developed. Since the large majority of respondents suggested positive improvements to the textbook, it was unnecessary to divide the comments into negatives and positives. Responses were then assigned to each category. The categories that emerged were: more relevant information; more visuals symbols; more content coverage; glossary and index; better text organisation; more practice questions; easier to read; more local examples; and better chapter summaries.

**Table 6.15 Suggested improvements to the textbook**

Categories	Number of responses	% of students who made comments
More relevant information	2	1
More visual symbols	29	31
More content coverage	5	20
Glossary and index	2	2
Better text organisation	1	1
More practice questions	3	1
Easier to read	30	40
More local examples	3	3
Better chapter summaries	2	2

Of the 465 respondents who participated in the study only 90 (19%) suggested improvements to the textbook studied. The most frequent suggestions to improve the textbook was that it should be made easier to read (suggested by 40% of the respondents). This suggestion was more frequent in the junior high and the upgraded high schools than in the other schools investigated in this study. Such findings are significant in the context of this study, since the category 'easier to read' may be related to the difficulties the students experience with the language and communication features of the text. As explained in Chapter 3, the students in the junior high and upgraded high school are usually of lower ability when compared with their counterparts in the private and the traditional high schools and, therefore, more likely to lack the literacy skills needed to deal with the language demands of the science textbook. Such findings underscore the need for differentiated science textbooks.

The second most common suggestion to improve the textbook studied (made by 31% of the students who responded to the questionnaire) was that the textbook needs to contain more

visual symbols. A closer analysis of these data revealed that the comments in this category were more common in the junior high, technical high and the upgraded high schools than in the comparisons schools. It is reasonable to infer that the students in the private high and the traditional high schools find it less difficult to interpret abstract concepts and, therefore, rely less on diagrammatic representations.

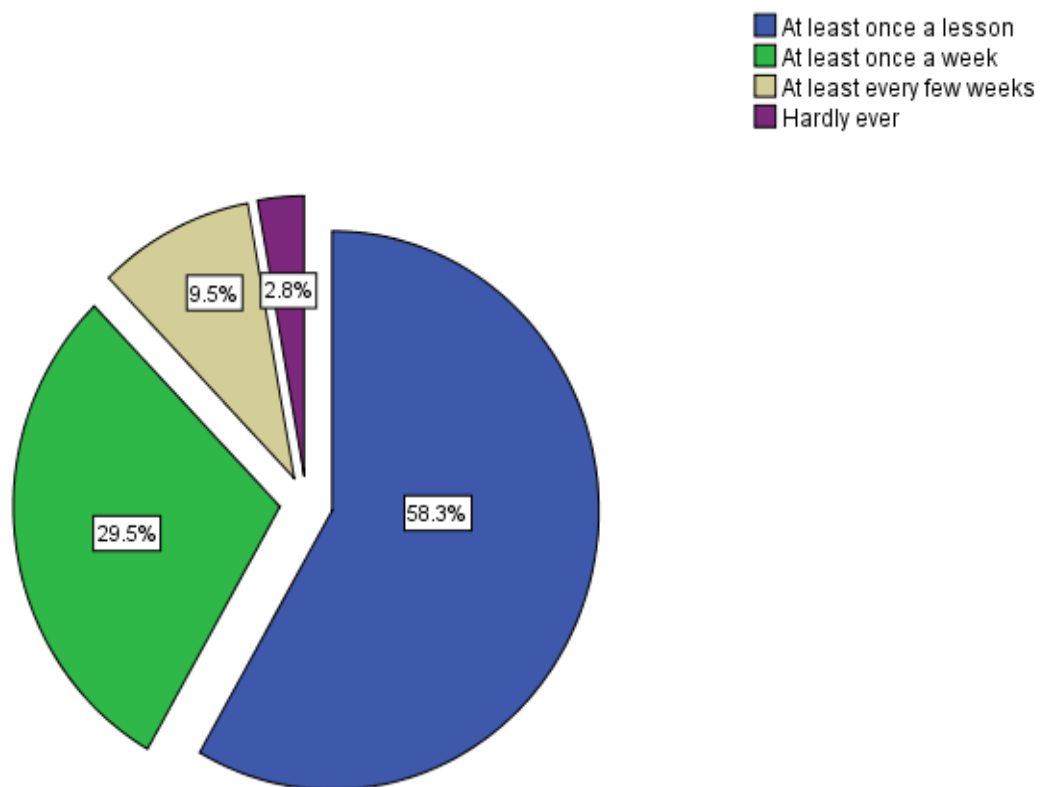
The students' suggestions are supported by researchers such as Agrawal et al (2013) who argued for more visual friendly representations to augment the subject narrative of science textbooks. In similar vein, Liu and Khine (2016) argue for better illustrated science textbooks that facilitate the interpretation of domain knowledge and help students achieve greater learning. The data are also supported by evidence from the teacher questionnaire in which the teachers commented that the science textbook would be much improved if the number of visual symbols were increased (see Section 6.4). This they maintained would further raise the students' interest in learning science.

The data in Table 6.16 also indicate that 20% of the respondents put forward improvements to the coverage of the course content. These suggestions were more common in the traditional high school where students expressed concerns that the textbook insufficiently covered the important scientific concepts that they needed to know for their exams. Such findings support the data from the teacher questionnaire (see section 6.4). Fewer than 5% of the respondents suggested improvements to the chapter summaries, local examples and text organisation.

### **6.15 Frequency of students' usage of their science textbook**

The frequency of students' usage of textbooks in Jamaican science classes was obtained from responses to the question "How often do you use your science textbook?" Response choices ranged from 'hardly ever' to 'at least once a lesson'. The data displayed in Figure 6.7 indicate that, on average, 58% of respondents reported using their science textbook at least once per lesson with almost a further 30% indicating that they use it at least once a week. These data are not surprising and accord very well with research findings in other parts of the world which show that science textbooks play an indispensable role in school science instruction (Fang & Wei, 2010; Irez, 2009). Indeed, the results seem to endorse some of the comments made by the interviewed teachers that science textbooks are infallible documents that are used as the 'de facto curriculum' in Jamaican science classrooms (p. 132). These results have

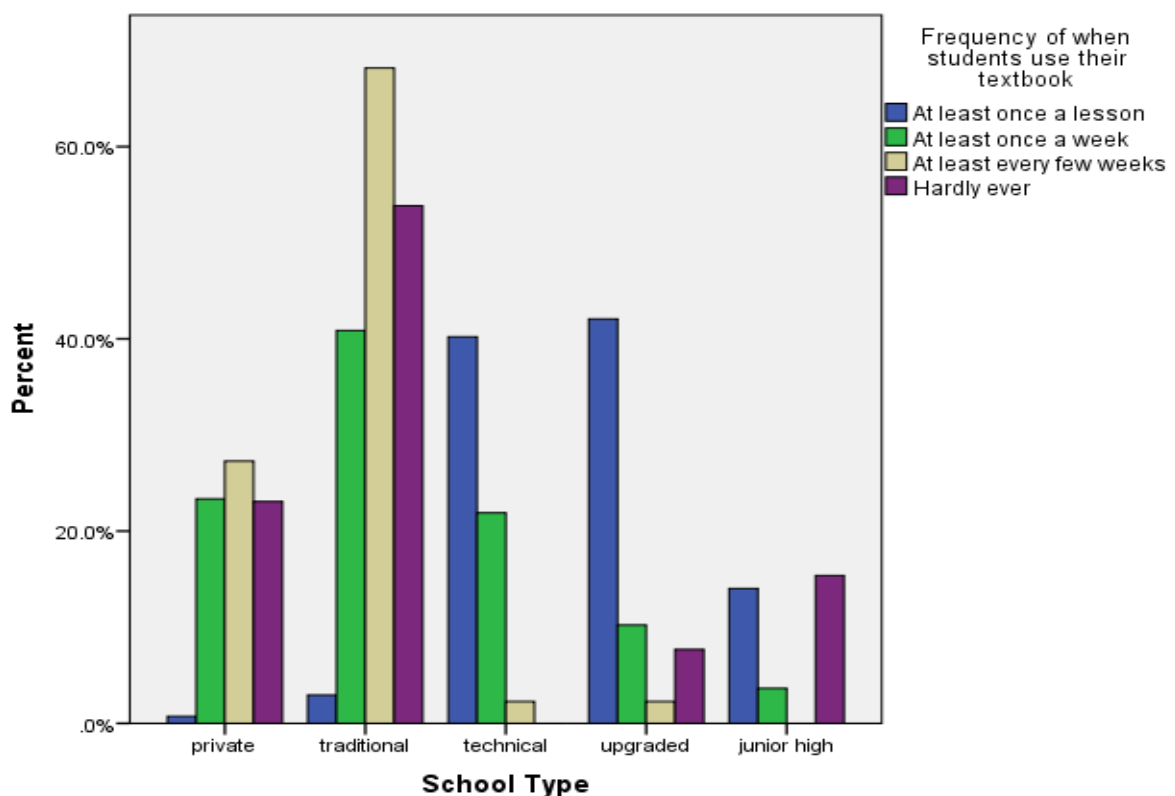
significant implications for the teaching and learning of science in Jamaican schools.



**Figure 6.7 Frequency of students' usage of their science textbook**

A closer look at the responses by school type shows variations in the frequency with which science textbooks are used in Jamaican classrooms. These results are presented in Figure 6.8. The data indicate that the most extensive use of science textbooks appears to be in the technical high and upgrade high school, where a large majority of the respondents (109 or 78% and 114 or 88% respectively) reported that they used textbooks at least once a lesson. Likewise, the most common response in the private high and traditional high school was that they use their textbook at least once a week. The proportion of students that responded, 'hardly ever' was highest in the traditional high school. These findings once again provide evidence of the heavy reliance on science textbooks by teachers and students in the junior high, technical high and the upgraded high schools. It is worth reiterating that teachers from the above-mentioned schools are less qualified than their counterparts in the private and traditional high schools and so are more likely to rely on textbooks to present a blueprint or road map of the science content to be taught. These results are consistent with the responses to a similar question in the teacher questionnaire (see Section 6.5).

Interestingly, some of the students in the junior high and upgraded high schools who selected 'hardly ever' explained in the interviews that the reason for their choice was because they did not have access to the prescribed science textbook. It would appear from the discussions with the teachers and from anecdotal evidence that the unavailability of science textbooks seems to be concentrated among the junior high, technical high and upgraded high where a large majority of the students are from low socio-economic backgrounds. In Jamaica, parents are responsible for providing current and updated textbooks for their children. This is often influenced by the availability of money, and the trade-off between spending on education or on other basic needs. In this respect, poorer families often lack the resources to fund the purchase of textbooks; consequently, children in such families are left without access to them (Figueroa, 2010). Such findings are also supported by evidence from the recent Global Education Monitoring Report (2016).

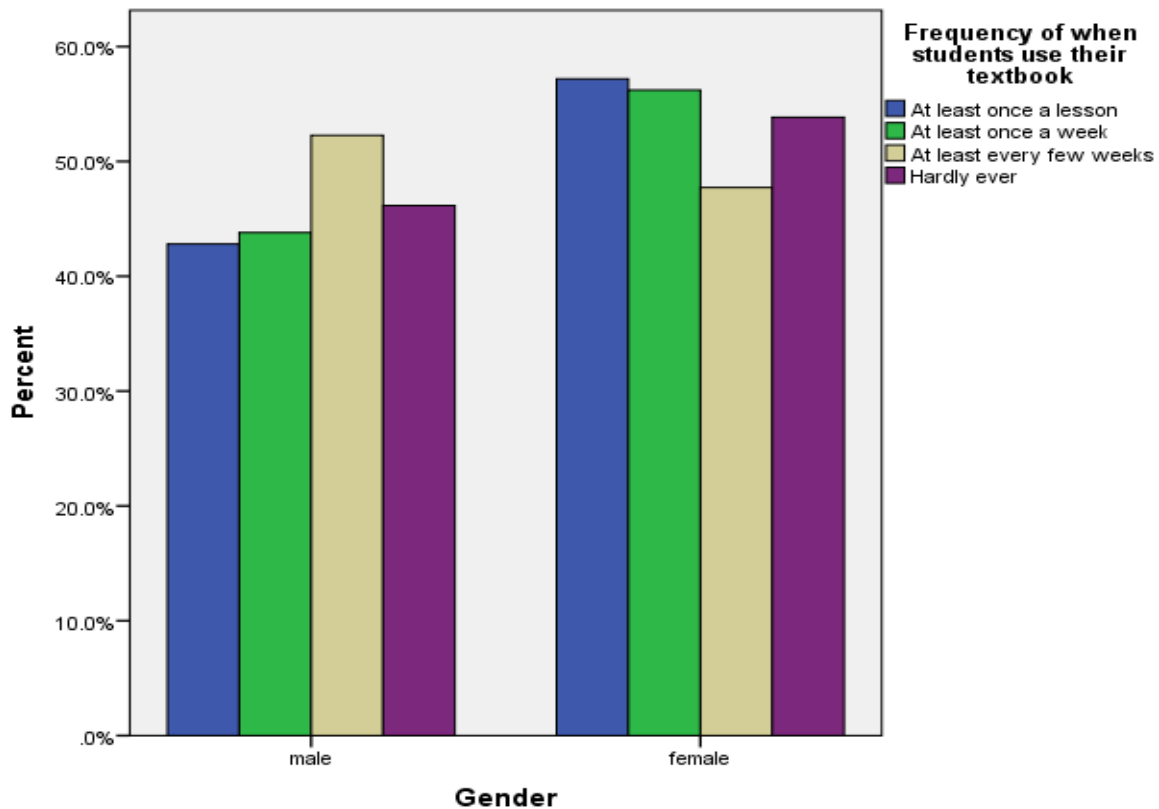


**Figure 6.8** Frequency of how often students use their science textbook as a function of school type

Analysis of the data revealed no significant relationship between the frequency of the respondents' use of the science textbook and their gender. As Figure 6.9 shows, a slightly higher proportion of females than males appear to report that they use their textbooks at



least once a lesson. Similar observations can also be made for the responses to ‘at least once a week’ and ‘at least every few week’ categories. However, a chi square test of independence revealed no significant association between gender and the frequency of use of science textbooks.



**Figure 6.9** Frequency of how often students use science textbooks as a function of their gender

### 6.16 Ways in which science textbooks are most frequently used

Question 7 on the questionnaire was intended to capture the ways in which science textbooks are most frequently used in Jamaican classrooms. This question used a tick box format and respondents were asked “How do you normally use your science textbook?”. This is an important question in the context of this research since the ways students use textbooks can signal their relative importance for content learning. In one of the studies reviewed in Chapter 1, Soyibo (1998) found that lecturing and textbook learning were pervasive methods employed by teachers in Jamaican classrooms. Indeed, in my ten years of teaching science in a large upgraded high school in Jamaica it was not uncommon to for teachers to ask students to read quietly and make notes on a topic. Considering the readability difficulties identified

from the Cloze test data (Section 4.3) and the teacher questionnaire data (Section 6.3) such practices raise serious concerns about some students' ability to comprehend their science textbook without the aid of their teacher. Thus, an important question for consideration is: To what extent are these practices still prevalent in the classroom?

Respondents were asked to choose one or more responses from a list of five options: background reading; answering questions; making notes; copying diagrams; and in other ways. For the purposes of analysis, all the responses were weighted equally. Data concerning students' responses are displayed in Table 6.16.

**Table 6.16 The ways in which textbooks are used in Jamaican science classrooms**

		Responses		Percent of cases
		N	Percent	
<b>Ways in which science textbooks are used</b>	Background reading	147	14%	32%
	Answering questions	293	27%	63%
	Making notes	342	31%	74%
	Copying diagrams	301	28%	65%
	In other ways	7	1%	2%
<b>Total</b>		<b>1090</b>	<b>100.0%</b>	

The data in Table 6.16 indicate that the most common response, chosen by 74% of the respondents, was making notes. This accounted for 31% of all responses. It would appear that the practice of science learning by note taking, continues to dominate Jamaican science classrooms as Soyibo (1996) observed in his comparison of communication strategies among three Caribbean high school biology textbooks. Note taking was also identified as one of the most common teaching and learning method in Hyacinth Evans (2001) *Inside the Jamaican Schools*. Table 6.16 also reveals that copying diagrams and answering questions were also frequent ways in which textbooks were used. These boxes were ticked by 65% and 63% of the respondents and accounted for 28% and 27% of the total responses respectively. These data confirm some of the earlier comments made by the students in respect of why they liked or disliked their science textbook and are broadly supportive of the findings on the teacher questionnaire (see Section 6.6). Responses under 'in other ways' were limited to just 2% of respondents, which suggests that the multiple choice responses offered were sufficient. A

closer examination of the data also reveals that the largest proportion of the respondents who ticked 'making notes' were from the junior high, technical high and upgraded high schools (see Table 6.14). This observation might indicate that teachers in these schools are more in favour of 'passive' forms of pedagogies.

**Table 6.17 Ways in which textbooks are used as a function of school type**

			Background reading	Answering questions	Making notes	Copying diagrams	In other ways	Total	
<b>SCHOOL TYPE</b>	<b>Private</b>	Count	39	42	19	29	0	49	
		%	80%	86%	39%	59%	0%		
	<b>Traditional</b>	Count	73	76	42	65	5	101	
		%	72%	75%	42%	64%	5%		
	<b>Technical</b>	Count	19	110	129	92	1	140	
		%	14%	79%	92%	66%	0.7%		
	<b>Upgraded</b>	Count	11	37	117	83	1	130	
		%	9%	29%	90%	64%	0.8%		
	<b>Junior High</b>	Count	5	28	35	32	0	45	
		%	11%	62%	78%	71%	0%		
	<b>Total Count</b>			<b>147</b>	<b>293</b>	<b>342</b>	<b>301</b>	<b>7</b>	<b>465</b>

### 6.17 Language used by respondents in various situations

In the research context discussed in Chapter 1, I commented on the intimate relationship between the cultural and linguistic background of science learners and textbook accessibility. In Chapter 2, I discussed the fundamental issue to do with language that I hypothesise continues to hinder classroom instructions – the fact that the language of instruction in both classroom discourse and science textbooks is JSE, even though many Jamaican students are not proficient in it, but fluent in JC. Mismatches of this kind can of course present difficulties for students in accessing science textbooks. In such settings, it is instructive to probe the extent of the diglossic situation in Jamaica and its impact on classroom instructions.

Respondents were asked to indicate the language they used in various situations. They were asked to choose from a list of five options: always JSE; mainly JSE; always JC; mainly JC; and equal amounts of JSE and JC. It should be noted that the languages of focus for the research are JSE and JC (these are the dominant languages spoken by Jamaicans); this meant that any other languages were ignored. The data collected are presented as Table 6.18.

**Table 6.18 Language used by respondents in various situations**

Items	Always JSE %	Mainly JSE %	Always JC %	Mainly JC %	Equal amount of JSE and JC %	Mean
Talking to science teachers	31	55	2	1	12	2.1
Talking to other students in science lessons	12	18	59	6	5	2.7
Language used in talking to friends at break	6	10	68	14	2	2.9
Language used in talking to family members	11	17	65	2	6	2.7
Language used in talking to parents	23	7	65	3	4	2.5
Language that is most used by science teachers	32	63	0	4	5	1.8

As can be seen from Table 6.18, JC is the language of choice for the majority of the respondents in the domestic situation. Indeed, almost two-thirds (65%) reported that they always use JC when interacting with family members. This is in sharp contrast to the 11% of the sample that said they were most likely to speak JSE with family members. In similar vein,

65% of the respondents stated that they only spoke JC to their parents as oppose to 23% who indicated that they always spoke JSE. Interestingly, the respondents who stated that they always spoke JSE to their parents were predominantly from the private and traditional high schools. These findings lend unequivocal support to Tomlin and Bryan's (2008) observations that in Jamaica the social class and education of the individual determines the kind of language they speak. As outlined in Chapter 5, JSE has become the language of intellect, of social distinction. Christie (2003) reported that in the educated homes of the middle class, children after four or five years of age are scolded for speaking JC, despite the fact that their parents use it constantly, and are thereby disciplined into talking JSE. JC, on the other hand, in its most extreme form, is spoken by the majority of Jamaicans, especially those who are in working-class positions. The junior high, technical high and upgraded high schools have their populations largely drawn from lower social levels and would therefore be predominately JC speakers.

We have previously seen that social class difference between private high and traditional high schools on the one hand and junior high, technical high and upgraded high schools on the other is paralleled by a difference in the Cloze test results of the respective children (see Section 4.3). It would appear that the language usage in the schools follows a similar pattern. Thus, in addition to being relatively lower in social class background and educational potential, the junior high, technical high and upgraded high school population is also correspondingly lower in JSE proficiency than the population in the private high and traditional high schools. This finding seems important in view of the already mentioned fact that JSE is the official language while the medium of instruction in science classrooms and the textbook language are JSE.

Several differences were found with respect to the choice of language to communicate with other students during science lessons. Almost 60% of the respondents said they always use JC, compared to 12% who indicated that they always spoke JSE. Eighteen percent of the students reported that they mainly spoke JSE while only 6% reported that they mainly spoke JC. Such results highlight the language diversity in the classroom and provide further justification for a change in attitudes towards JC.

The data in Table 6.15 also reveal that 86% of respondents reported that they always or mainly use JSE when talking to their science teachers. This is very different from to the 3% of

the sample who stated they always or mainly use JC. These data support the findings of Bryan's (1997) study on language usage in a Jamaican primary school. In that research, she observed that JSE was infrequently used in the classroom when students talked with their peers but was used even less outside the classroom. It is pertinent to note that Bryan also reported that teachers themselves reverted to JC and only sometimes uses JSE when they were outside the classroom.

## CHAPTER 7

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### ANALYSIS OF INTERVIEWS

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#### 7.1 Introduction

The discussion of the Cloze task performance data in Chapter 4 and the questionnaire data in Chapter 6 give insights into the accessibility of science instructions to Jamaican students, the major issue addressed in the research question discussed in Chapter 1 (Section 1.8). The students' and teachers' questionnaire and the students' performances on the Cloze task confirmed that many students do find science instructions inaccessible. However, the use of questionnaires and a Cloze task as research methodologies restrict the amount of data collected directly from the participants. Thus, to strengthen the validity of the data collected and to facilitate triangulation, a number of interviews were carried out with teachers and students from each of the five schools investigated in this study. These interviews were designed to probe more directly teachers' and students' judgment on the extent to which science instructions are accessible in their school and classroom context. Interviewing is an appropriate technique to use when probing teachers' and students' attitudes and opinions (Cohen & Manion, 2013; Thomas, 2016).

As outlined in Chapter 3, a semi-structured approach was used to conduct these interviews. This type of interview was used because of the flexibility it offers. With semi-structured interviews, even though an interview guide was prepared in advance, I was not limited by it. Moreover, the nature of this study was to be exploratory. In that sense, some preliminary analysis was conducted after each interview. The purpose of this analysis was to identify themes and topics not listed in the set of questions or value prompts but that were brought up in conversation by the participants themselves. If such items were found, new questions and dialogue prompts were added to explore these topics with later participants. The interview process was thus in a state of continuous refinement. This chapter presents the analysis and discussion of these findings.

#### 7.2 The interview protocol

All interviews were conducted using a semi-structured guide from which I selected questions, depending on the direction of the conversation. While the interview protocol provided a relatively systematic coverage of all themes, the participants, being considered co-

constructors of meaning, were free to suggest related topics, and I often devised questions in an attempt to follow up any interesting points they made. The interview topics were selected to test the theoretical assumptions prevalent in the existing literature and to give participants opportunities for subjective spontaneous contributions.

One theoretical benefit of using semi-structured interviews is that they are more likely to allow the participants to share in directing the flow of the interview, so they do not feel subordinate to the interviewer. Nonetheless, it is important to recognize that while the balance of power may be more fluid than in other types of interviews, and the interviewee is treated as an expert, ultimately the interviewer remains more in charge. I posed the questions and used probes and hence controlled the interview's 'referential content' (Briggs, 2003), and could even alter its direction if there was too much deviation from the topics that I deemed to be of interest or focus.

The semi-structured interview has been criticised by researchers in the field (Domyei, 2007; Richards, 2009), who have considered it as a compromise because it draws "to some extent on both of the other types [i.e., structured and unstructured]" (Richards, 2009, p. 185). This is in fact true: a researcher knows that certain key areas will need to be identified in order to compare the interviewees' experiences of these. An element of structure is therefore important. On the other hand, a general picture is unlikely to reveal the undercurrents of feelings, expectations, opinions, and so on that will help investigators understand the reasons for what they see happening. For this, more open-ended questions will be needed to allow interviewees the freedom to bring to the surface aspects of their experience that would otherwise remain hidden. Thus, the advantage of semi-structured interviews and the interview guide they are based on is that they give the interviewer the reassurance that s/he has carefully decided how best to use the limited time available in an interview situation. The guide helps make interviewing a number of different people more systematic and comprehensive by delimiting in advance the issues to be explored (Patton, 2002).

### **7.3 Students' group interviews**

Group interviews were adopted to gain further insights into the students' judgment of instruction in their science classroom. Group interviews have been increasingly used in qualitative research to collect information for a wide range of purposes. However, the main advantage of this approach to the fieldwork in this study was purely practical. Initially, most



of the informants cited unwillingness to engage in individual interviews but agreed to participate in group discussions after being convinced about the benefits of the research study. Furthermore, some participants were also unwilling to commit to a waiting times schedule for completion of individual interviews. Thus, group interviews were more viable than individual ones. Notwithstanding these limitations, the discussions obtained detailed information about the groups' feelings, perceptions and opinions on important issues concerning science instructions and language ideologies in Jamaican classrooms.

All the interviews lasted for forty five to fifty minutes and were recorded using a digital recorder. On the request of the head teachers in each of the five schools, a teacher was present throughout the interview process. The teachers sat at the back of the rooms and observed and only intervened when some of the groups got disruptive. In a few instances, they prevented other students from entering the room. This was rather very helpful.

The group interviews questions were similar to those used on the questionnaire. In this way, triangulation of data from the questionnaires and the group interviews facilitated the validation and consistency of the research findings. This helped provide a more enriched and balanced account of the respondents' attitudes towards and judgement of science instructions in their school. This form of data collection is supported by researchers such as Creswell (2014).

Group interviews in the technical high and traditional high schools were carried out in offices of the head teachers but this was unfortunately not possible in the junior high school where all interviews were carried out in a small secluded section of the lunch room. Even though the arrangement of the place allocated for the interviews did not allow other people to hear our conversations, both the participants and I could hear the noise from the lunch room and in certain cases we even had visual contact with other students who were passing by. This was a limitation for interviews carried out in that school for two reasons. First, the quality of interviews recordings was poor as the background noise was sometimes too loud and in some instances, overrode the participant's voice. Secondly, both the participants and I were easily distracted by other students who would approach us. Of course, whenever people approached the room to talk to us, I would stop the tape recording, explain that we were in the middle of an interview and start the tape recording again as soon as they left. This was an

issue that perhaps remained until the end – to at least some extent – but I endeavoured to minimise its consequences as much as possible.

During the interviews, an informal environment of conversation was developed to make the participants feel comfortable and, in turn, increase the likelihood of open, interactive dialogue. Students could talk to each other, ask questions and express doubts and opinions without being interrupted by me. This sometimes made it extremely difficult to keep participants focussed on the topic. Indeed, in one school, the students were more interested in talking about Premier League football than they were about their science instructions. It was only when their teacher intervened that that they refocussed and engaged in discussions of some of the salient issues related to the research questions.

Throughout the interview process, I adopted an understanding attitude toward students and was not critical of them. When students made disparaging remarks about their teachers' use of textbooks or made other comments which could be deemed as inappropriate, I took a non-judgemental stance. Instead, I tried to be understanding but at the same time encouraged the students to conduct the interview in a respectful way. Perhaps the informal nature of the discussion coupled with the fact that I was dressed casually and did not look like a 'teacher' or a person in authority helped the participants to feel more at ease to 'open up' and engage in meaningful ways.

The students' responses produced a considerable amount of textual data regarding textbook and language usage inside and outside their science classroom. The interviews were transcribed in entirety and an example is presented as Appendix E. Although there has been some debate as to the necessity to transcribe audio interview data verbatim (see Halcomb & Davidson, 2006) it was felt that focusing on selected sections of the data might not capture the nuances of students' observations and might therefore fragment the data. Thus, presenting the students' responses in their written entirety was transparent, rigorous and integral to the analysis and interpretation of the verbal data.

#### **7.4 The interview environment and the researcher's positionality: 'Insider' or 'Outsider'?**

One of the distinguishing features of good qualitative research is the recognition that it embraces subjectivities and seeks to understand why they occur. Indeed, Merriam and Tisdell (2015) argue that an important strength of qualitative research is that it engages with

people's subjectivities. Asselin (2003) has suggested that researcher subjectivity can serve many purposes; for example, the researcher's affective responses can offer significant clues to phenomena that need to be analysed further. The personal and professional interests of many qualitative researchers form the basis for initial questions and choices of participants.

In this research study, my personal and professional experiences were contributing factors to the choice of the research problem. I had been both a science student and a science teacher in Jamaican schools, and could identify and empathise with many of the issues related to school science instructions and language ideologies. Indeed, during my time spent teaching in Jamaica, I found that, although science textbook reading was frequently assigned, many students did not actually do it and, if they did, many complained that they did not understand the substantive content. Furthermore, throughout my adult life, I have both accepted and rejected the prevailing view that JC is a bastardised substandard dialect or 'broken English' and that JSE was the measure of intellect and achievement. It is these experiences, I believe, that make the issues of science instructions and language especially urgent and compelling.

In some respects, having a similar cultural, linguistics, ethnic and national heritage as the participants proved advantageous and gave me more rapid access to data which might have eluded an 'outsider' researcher. Two reasons are put forward to explain this advantage. First, the participants felt more at ease talking to me because they identified with me as a fellow Jamaican and hence afforded me a degree of social and cultural proximity. Moreover, having completed most of my formal education in Jamaican institutions, I could relate to some of the substantive issues that were important to the participants. For this reason, participants felt that I understood their problems and would be able to tell their stories in an authentic manner. However, this insider status meant that at times I often needed to step back to put distance between myself and the participants so that I could describe their experiences as accurately as possible.

Secondly, similar advantages arose from my familiarity with the language situation as explained in Section 2.9. For this reason, I spoke in both JSE and JC and encouraged the participants to speak in either or a mixture of both languages if they so desired. Nevertheless, it is perhaps fair to say that while most of the students found the process rewarding and empowering, some found the experience intimidating at times and, consequently, were

incoherent or gave conservative responses to some of the salient issues raised in the discussions.

It is also the case that the identity and/or background of the researcher can influence objectivity and the social dynamics that shape the qualitative interview irrespective of whether the researcher is an 'outsider' or 'insider'. Even when researchers carry out research with participants who share the same ethnic background and other characteristics as them there might still be certain shortcomings. Doors may be closed as the researcher becomes too immersed in the situation to be objective (Ganga & Scott, 2006). For instance, the researcher might be so familiar with the culture, attitudes and lifestyles of participants that he/she might be predisposed in relation to the findings of the research. The dilemma of being both insider and outsider has been described by Le Compte and Preissle (1993) as "a schizophrenic task. We risk losing the outsider's perspective by over-identifying with participants, and we risk losing the insider's perspective by under-identifying with them" (p. 97). I was conscious that throughout the research process my researcher's role shifted between these two poles, with their different perspectives.

In relation to my class background, again it was not easy for students to position me as a middle-class or working-class individual as I do not have any recognisably classed accent and my dress code was quite neutral. On the one hand, some students could view me as a middle-class individual due to the level of my educational background and the fact that I was a PhD student living in the UK. On the other hand, some students could position me as a working-class person because of my ability to fluently speak the basilectal version of JC.

Despite my attempts to minimise any possible signs of power differentials during data collection, it could be argued that the way I viewed both the participants and the data collected from them was informed by my own experiences and, therefore, my own background. In this case, it is important to acknowledge the possible ways this might influence the data interpretation and dissemination by being self-reflexive.

## **7.5 Developing a thematic analysis**

The data were analysed using the conceptual framework of thematic content analysis outlined by Braun and Clarke (2006), which was earlier used in the analysis of the student questionnaires (Section 6.13). According to Braun and Clarke, thematic analysis is a useful and

flexible analytic method that enables researchers to identify patterns of meaning or themes within data. Since it is not theoretically bound to any particular theory, it was felt that this form of analysis was appropriate as it would reconstruct the data in a rigorous and meaningful fashion, while remaining true to participants' accounts.

## **7.6 Coding data**

Following the group discussions, the data were manually coded and analysed. My main objective was to make a relatively large amount of the data more manageable. This was achieved by first breaking the interview responses down into smaller parts and then putting them back together again in clusters that summarised the ideas and issues within the interviews. Throughout the process, my central aim was to move from the concrete form of the data – the words the participants spoke in response to the questions – to the more abstract ideas that captured the meaning of responses (Charmaz, 2006).

There has been some debate about the use of 'manual' vs 'software' coding in qualitative research (Basit, 2003; Saldana, 2015). Researchers such as Saldana (2015) have argued that using qualitative data analysis software adds rigour to qualitative research and is therefore a "vital and indispensable tool" to the research process (p. 28). In agreeing with Saldana's position, Richards and Richards (1994) suggested that using computer software to aid analysis improves validity and auditability of qualitative research, helps in examining possible relationships between the themes, increases flexibility and saves time. However, Basit (2003) has cautioned that while software can substitute for the uncertain and slow process of manual searching it cannot understand the nuances of meaning of a text. He suggested that manual analysis is the only way to extract deep and subtle meaning.

A manual scrutiny technique was employed on the basis that the datasets were relatively small-scale and thus it was a manageable project to analyse in this manner (only five group interviews were conducted). Moreover, even though using software would have made the process more flexible and, arguably, simpler in tracking the emerging themes, adopting a manual coding approach allowed for a more thorough interrogation of the data.

For the group discussions, an inductive approach similar to that used in the quantitative analysis of the questionnaires was used to generate substantive codes from the data. Such an approach was considered appropriate since it involves analysing data with few or no

preconceived ideas of what will be found. Indeed, it necessitates that the researcher begins with an open mind and the actual data themselves are used to derive the structure of the analysis. The method of analysis described in this section has been discussed extensively elsewhere in this study (see Section 6.13) but it is worth providing examples of the initial and final coding frame work used in the data generated from the actual interviews. These examples are presented as Tables 7.1 and 7.2.

**Table 7.1 Example of the initial coding framework**

Interview transcript	Initial coding framework
<p><b>Wilton:</b> OK, so what do you think makes a great textbook? Any one wants to talk about that ... What makes a great textbook?</p>	
<p><b>Tammi:</b> I think a good textbook is one in which the language is clear and easy to understand ... Umm... (pause) It should be well written and have some really good pictures to explain come of the scientific ideas. A good textbook should have interesting diagrams and pictures. I think I learn a lot from diagrams and pictures. Oh... and sir, it must have enough information so we can study and pass our exam.</p>	<p>Language Visual representation Subject narrative</p>
<p><b>Kameka:</b> Sir, a good textbook is one that doesn't have a lot of difficult scientific terms; it must be easy to read and understand. It is one that doesn't jump between ideas but link them in a logical way.</p>	<p>Scientific lexis Text organisation</p>

**Table 7.2 Final coding framework after reduction of the categories in the initial coding framework**

Final coding framework	Initial coding framework
Language and communication	<ul style="list-style-type: none"> <li>• Scientific language</li> <li>• Scientific lexis</li> <li>• Visual representation</li> <li>• Text organisation</li> <li>• Subject narrative</li> </ul>
Scientific discourse	<ul style="list-style-type: none"> <li>• Science talk</li> <li>• Science text</li> <li>• Factors affecting scientific discourse</li> <li>• Role of the teacher in scientific discourse</li> </ul>
Language ideologies	<ul style="list-style-type: none"> <li>• Attitudes towards JC</li> <li>• Hegemony of JSE</li> </ul>

## 7.7 The findings

### 7.7.1 Attitudes towards JC

Throughout the data, statements by students made it obvious that they held negative attitudes towards the use of JC as the medium of instruction in the classroom and the language of science textbook. Furthermore, there seemed to be a tremendous lack of awareness of the existence of JC as a distinct language variety. It was clear that many of the participants considered it as a corrupted and inferior ‘dialect’ of the more prestigious lexically-related standard, a version of English which had to be corrected by the education system. Thus, it is not surprising that pejorative terms such as “broken English”, “back yard talk” and “bad English” were routinely used to describe JC throughout the interviews. For example, one student (Nyree) expressed that “a wouldn’t feel good about writing a book in JC cause you have to remember that Jamaican patwa is a broken language mix with English”. In similar vein, Patrice voiced that “JC is no more than a form of ‘broken English’ which only should be used when we are talking to friends and families”. Nyree’s and Patrice’s statements clearly suggest that they do not recognise JC as an independent variety, but rather as one that exist only relative to English. These findings are not surprising and mirror those of Devonish

(2004), Jettka (2010) and Wassink (1999), all of whom highlighted the pervasive negative attitude towards JC, albeit there was some evidence that such attitudes might be weakening.

Many of those who expressed negative attitudes towards the use of JC in the curriculum offered familiar reasons such as the inferiority of JC with respect to JSE, and economic and social limitations. For instance, one student (Ann)'s attitude towards the use of the vernacular finds expression in her view that "JC is 'back yard talk' and not a real language. Use of Jamaica Creole shows a lack of ambition and makes you unemployable as no one will employ you when you speak Creole". So too for Barbara who said "To get a good job, you need to speak good English. That is why I am totally against using patwa (JC) in schools. It's just ridiculous."

Two points are particularly noteworthy. Embedded within Ann's and Barbara's analyses is a conception that in Jamaica, languages, as is the case for social class and race (see Clarke, 2016), exist in a hierarchy. In this situation, JSE is held in high esteem and has become culturally more powerful than the indigenous original (JC) that is devalued. This is confirmed by Devonish and Carpenter's (2007) and Craig's (2006) evaluation of the ethnolinguistic hierarchy of Jamaica, according to which JC constitutes the lowest variety.

Another important question in the context at hand concerns issues related to social class. Implicit in Ann's and Barbara's responses is the notion that there is a direct correspondence between social class and language use. In this formulation, the use of JC inhibits social mobility whilst the acquisition of JSE is viewed as an apparent passport to higher status. This is an interesting view and one that is consistent with Bryan (2000) who argues that in the Jamaican context language and speech are clear social indicators.

Milroy and Gordon (2003) argue that socially highly valued language forms constitute symbolic capital which is potentially convertible into economic capital. Thus, the ability to speak JSE fluently underpins the successful acquisition of 'white collar' jobs. The assumption made here is that procurement of these jobs constitutes upward mobility. Such linguistic imperialism which emerged from the colonial system as a hegemonic tool, found itself with an intellectual legitimacy that has since been used to justify class domination. One deleterious consequences of this pattern of thought is that it projects an increasingly tenuous ideology that reinforces and endorses inequalities between classes.



At the same time, some of the interviewees acknowledged the importance of JC insofar as it relates to culture and identity. For instance, one student (Janice) from a junior high school said:

Even though I don't think teachers should be teaching in patwa (JC) in the classroom, patwa is still part of our Jamaica culture. It is important for cultural events such as festival. Also, our musicians use patwa in their songs and everybody knows they are Jamaican when they travel.

Along similar lines, another student from a traditional high school (Robert) asserted that:

I wouldn't feel good about it [using JC as the language of science textbook] ... a think if you only going to make it only Jamaican based and appreciating you culture you can write it there but a think that would have to be more a culture thing, a cultural setting more than a science setting because when you learning science you not only learning to be local you learning to be international ...

The above accounts highlight considerable ambivalence to JC usage and raise two important considerations. First, they highlight the significance of the relationship between language and culture. To deal adequately with this issue, Alleyne's (1989) articulation of the inseparability of JC and Jamaican culture is pertinent. As discussed in Chapter 2, Alleyne argues that JC is one of the main forces contributing to a distinct Jamaican culture and identity, leading to an increased use by upper and middle class members who by this demonstrate their loyalty to the Jamaican nation. In this sense, JC is observed as the language of cultural vitality, playing a central role in the retention and transmission of traditional values. Indeed, from my own experience of living and working in Jamaica, it seems reasonable to say that most Jamaicans are attracted to films and radio programs delivered in JC. They love their proverbs and folklores in Jamaica Creole; it is also not uncommon to hear Jamaicans express the view that Jamaica Creole jokes are just not as humorous when put into JSE. Moreover, the cultural vitality of JC as a medium of artistic expression is also demonstrated in the works of international poets and reggae singers.

There is, however, a second, related but distinct view. This second position recognises the rich and complex interrelationships of language and power. Central here are two assertions: power is exercised in conversation and other forms of expression between people; and language is used as a form of resistance to those in power (in Foucault's terms). In this sense,

JC has been used as a medium of conscious resistance to linguistic imperialism. Here, the importance of story-telling and the oral tradition inherent to African culture is kept alive and serves as the spirit of resistance, combined with good humour and a spirit of joy which had become part the disposition of many Jamaican people.

### *7.7.2 Hegemony of JSE*

As we have seen in Chapter 1, linguistic hegemony has been identified and can be defined as what is achieved when dominant groups create a consensus by convincing others to accept their language norms and usage standards. In the case of Jamaica, the argument adduced so far in this thesis is that JSE has had a hegemonic influence which has resulted in the marginalisation of JC in terms of acquisition, learning and use. Such hegemonic status and global currency has been used to trump any argument for the elevation of JC from its lowly status or for its use as an educational tool. This has resulted in the relegation of monolingual JC speakers to second-class citizenship, because their language is considered an unsuitable subject for school curricula and for polite or official discourse.

Evidence of JSE as a hegemonic language was pervasively present throughout the discussions with the students. Indeed, many of the interviewees supported the use of JSE as the sole medium of instruction because they saw it as a powerful economic tool for development and commerce in an increasingly globalised world. For example, one student (Tajay) expressed the view that:

English should be used in schools because it is the language spoken by some of the world's largest countries and taught by others as second language. So, in the business world it is very important.

Another student, George said:

English is a universal language and countries like ours have to depend on English for trade on the global scale to help economic development. Therefore, it is important for us to be good at it to get jobs.

Thus, it would seem that proficiency in JSE has become something of a commodity, valuable both because of its utility, described by former Jamaican prime minister P. J. Patterson (2003) as "one of our competitive advantages in terms of communication and economic development", as well as for its image as a form of cultural capital. Such ideology has given JSE an unparalleled status and usage among the educated class and in the nation as a whole.

The dominance of Standard English is “asserted and maintained by the establishment and continuous reconstitution of structural and cultural inequalities between English and other languages” (Phillipson, 1992, p. 47).

Yet another important point raised by the students’ discussion concerning hegemonic ideologies deals with issues surrounding the association between speakers of JSE and intelligence. Pertinent to this discussion is the argument put forward by controversial linguist John Honey. Honey (1997) argues that those who are not taught to speak and write in Standard English are not as intelligent as those who speak and write it. He sees Standard English as superior to all other forms of language and holds that to achieve equality all children should be taught Standard English and use it in everyday communication. He suggested that “speakers of non-standard social and regional dialect forms suffer comparable forms of disadvantage” (1997, pp. 21-22). As problematic as such assumptions are, Honey’s arguments resonate with those of some of the interviewed students who accept the view that people who predominantly speak JSE are more intelligent and are more likely to be successful than those who are primarily JC speakers. For example, Kameka said:

I don’t agree with mi teacher using patwa (JC) to teach science; it just wouldn’t sound intelligent ... People who can talk English good are more intelligent than people who use patwa.

Another participant (Joe) put it this way:

When people talk patwa especially on TV them sound vulgar and dunce but everybody will listen to the ones who talk English cause dem (they) sound more intelligent.

These statements highlight an ideological acceptance of the hegemonic order. Such beliefs, which denigrate the value of JC, illustrate the effectiveness of the ideology that has shaped our view of language in our society.

### *7.7.3 Scientific Discourse*

The centrality of scientific discourse or ‘science talk’ as part of scientific practice and the social nature of science was outlined in Chapter 2. Through this discourse, students can bring a critical stance towards ideas based on reasoning and learn to engage in scientific argumentations and explanations. Moreover, through scientific discourse, students gain understanding of the nature of science and the ways in which it is changing, making sense of

scientific ideas and communicating these ideas to other people. Such a view is also consistent with Jay Lemke's (2012) articulation of the importance of scientific discourse. Lemke writes that talking science enables "learners to clarify the meaning of technical terms or concepts, develop new understanding and vocabulary, and communicate method of scientific reasoning and inquiry" (p. 1).

The importance of discourse in the context of science classrooms was underscored in the participants' responses when they were asked to complete the statement: "I learn best in science when ...". One student (Jack) commented that "I learn best when we have discussions. Discussions help me better to understand what I am learning". Another student (Andrew) nodded firmly in agreement before noting that, "I learn best in a relaxed atmosphere that focuses on discussions rather than note taking". Andrew's comment generated broad agreement within the group. This suggested that this was a preferred approach, with students, 'talking their way' to understand scientific concepts and principles. Indeed, one student (Sharon) gleefully described how her interest in science had developed because of the science discussion lessons. As she said, "I learn best when the teacher actually discusses the topic with me and make it sounds interesting. I use to hate science in primary school because we were always taking notes from a book but now I really enjoy the interesting discussions we have in class". This confirms the observations of writers such as Osborne (2010) and Scott (1998) who point to the impact and centrality of discourse to the learning of scientific practices.

The participants' responses also highlighted the role of the teacher in guiding meaning making interactions within the classroom. Indeed, most of the participants expressed the idea that their teacher was central in facilitating the discussion process. The following quotations illustrate this: "My teacher is passionate and knowledgeable about science. She brings interesting topics for us to discuss and make sure everyone is contributing whether they are good or bad at science" (Mark) and "I enjoy the discussions in science, my teacher makes them interesting and I learn things I didn't know before" (Mary). These observations indicate that undoubtedly teachers have a major impact on pupils' engagement in science discourse. There is considerable resonance with the findings of Scott (1998) who highlighted the importance of the teacher in talking science.

A crucial issue that it is worthwhile to consider in the context of the preceding discussions is that of the classroom environment. It is well known that in Jamaican science classes, as is the case in many other countries (Yore, Bisanz & Hand, 2003), discourses are dominated by teacher-directed, expository instructions, with little opportunities for students to engage in discussions. Indeed, this was the case in all the classes I observed during my visits to the schools investigated in this study. The students were asked questions that typically required a short response or had one correct answer. Although such practice allowed the teacher to cover a lot more material in the available time, it was unlikely to promote reasoning and critical thinking. Indeed, if one accepts the centrality of the role of the teacher in promoting students' enculturation into the practices of the science community and developing conceptual understanding through 'science talk', the challenge becomes one of creating a classroom environment that supports student-directed and collaborative interactions. This observation supports the position of Mant, Wilson and Coates (2007) who argue that giving space for discussion of ideas in science enhances the variety of students' experiences and develops their critical thinking skills.

#### *7.7.4 Socio-linguistics and scientific discourse*

The extensive body of research and scholarship (reviewed in Chapter 3) provided by researchers such as Brown (2006) and Reveles and Brown (2008) points to the intricate connection between socio-linguistics and scientific discourse in coming to an understanding of the natural world. Furthermore, and perhaps more crucially, these studies have highlighted how students' social backgrounds, cultural beliefs and practices and linguistic repertoires influence how they participate in science instruction and discourse. In one such study, Brown (2006) considered the issue of communication and interaction patterns on science learning among students from various cultural and linguistic backgrounds. More specifically, Brown built on earlier studies of classroom discourse and interaction to consider students' diverse views of science and their experiences in school science. Concentrating on the conception of discursive identity as an analytical category for cognising student learning, he analysed the interactions in two science classrooms, meticulously detailing the linguistic tools that helped to shape individual access to classroom discourse. The results showed that students expressed difficulties and resistance in adopting the discursive practices of science. He concluded that in some situations science discourse can serve as a barrier that prevents some

students from assimilating into the culture of science. The findings of Brown's study have important implications for science instructions and discursive norms in Jamaican science classrooms and raise questions related to equity and access in science education.

Throughout the interviews, the dominant view of the students was that their home language was not valued within the formal education context and, consequently, that teachers did not promote or encourage them to express scientific ideas in JC. For example, one of the students (Henry) commented that "whenever we answer a question or make a comment in Creole our teacher would rephrase it in Standard English to make it clearer to the class", and this was met with nods of agreement from the others. Another student (Karla) described how in one science lesson on photosynthesis, she was asked by the teacher to explain how plants got their energy. She responded by explaining that "dem get energy from de sun". The teacher whilst accepting this response told her to 'speak properly'. In similar vein, Joan explained that when she used Creole in science discussions her teacher would often ask her to start her answer again but this time use Standard English. The discourse patterns in these classrooms appear to be widespread across the five schools investigated, with teachers undervaluing the children's home language and experience.

In general, the findings from the student responses provide large-scale support for the earlier studies of socio-linguistics and interaction patterns in learning science undertaken by Lee (2004) and Warren et al (2001) and resonate in some respects with the more recent observations made by Brown (2006). The latter identifies the sociocultural and sociolinguistic factors that influence how, when and in what conditions marginalised students chose to engage in science discourse.

If one accepts the notion that the use of talk in science classrooms is fundamental for exploring scientific phenomena, reasoning scientifically and arguing from evidence, then it is crucial that a linguistically rich, non-threatening environment is established. Within this paradigm, linguistic diversity is infused and encouraged throughout the classroom by including both JSE and JC into science discourse and science instructions. In this way, learners will feel that their home language is valued and consequently, will free to express themselves in these discussions. Such a practical and common-sense approach offers significant pedagogical advantages as reported consistently in bilingual education literature (see, for example, Cummins, 1994, 2000).

Furthermore, the continuous tension between students' home discourse and modes of non-vernacular classroom discourse has been identified in many studies as one of the most influential factors that limit students learning (Barton & Tan, 2010; Brown, 2006). Most often, the students' dominant language used in their broader social world is undervalued because teachers do not easily recognise it as being valuable in providing language-rich and contextualised learning experiences. Thus, students from language backgrounds that differ from that spoken by the teacher face more serious learning challenges than students whose discourse background matches that of the teacher.

As we have seen from the discussions so far, most Jamaican students are not proficient in JSE (the language of science instruction) but are fluent in JC. These language demands pose significant challenges of cognition and leave students with the impression that science is difficult, reserved for cognitive elites and regimented (Lemke, 1990). Yet, according Simmons-McDonald (1996), students are not encouraged to express their conceptual understanding of scientific processes in JC and science teachers continue to perpetrate a monolingual order of discourse. It is entirely appropriate, therefore, that this research consider the broader relationship between scientific discourse, language and science learning in the Jamaican context. More specifically, the study investigates from the students' perspectives the extent to which their everyday way of speaking is valued in educational settings.

An additional perspective that may be especially salient to consider in the context of this discussion is the issue of linguistics discontinuity between the home and school. Many studies of communication and interaction patterns among students and teachers have shown that differences in the functional use of language at home and at school can affect conversational dialogue within the classroom. Indeed, Covington et al (2005) argue that when there is linguistic discontinuity between home and school, Creole-speaking children may perceive that their language is not valued. Such perceptions may result in lower self-confidence and self-esteem. In such a situation, students are more likely to become passive and restricted in science discussions.

#### *7.7.5 Language and communication*

With respect to the language of science and science instructions, many of the participants highlighted similar challenges as those expressed by their counterparts who responded to the questionnaires. As was the case with the student questionnaires, the majority of the

comments focussed on the lack of understanding of specialist vocabulary and scientific terms. For example, Patrice commented that “I am not very good at reading and writing, so I struggle to make sense of the scientific words. Most times when I asked my teacher for help, she tells me to look up the words in my textbook”. Similar sentiments were expressed by Mark who explained that “I understand the scientific concepts in class discussions but I get low marks in my test because I am not able to express myself using scientific words properly. I find that I do better with multiple choice questions”.

Some students were also critical of the scientific lexis of the textbook. Take, for example, Jane who said, “I think it [the textbook] is very complex. Reason being that some information and explanations are not quite broken down as you would want them. So, most times I struggle to revise for test and do homework from it”. Jane further explained that “science have a lot of difficult vocabulary and sometimes when you are reading these words they are difficult to make sense of [pause] so it would be easier to read if the words were broken down simpler”. In adding to the thoughts expressed above, Kameka when asked what she thought about the language of her science textbook said:

My textbook [pause] with the aid of my teacher after he explain it in class and I have a level of understanding to know that if I am going to use the textbook it would [laugh] would be easier to understand when you use the notes from the class with the textbook will give us a better understanding. I would have to say though that I struggle to read it without my teacher breaking it down.

What is clear from the above observations is that the register of science, which is full of precise definitions and subtle variations of meanings, poses serious problems for science learners. One possible explanation for such difficulties is that the register features required for science differ in significant ways from the register of social everyday interaction, making it necessary for even those students for whom JSE is already well-developed for everyday tasks to expand their linguistics repertoires and learn to be more precise in their linguistics formulations to meet the demand of science. Although all Jamaican students face this difficulty, JC speakers are at a particular disadvantage, because they may have both limited resources in JSE and less experience with the register of science. This situation, I contend, is exacerbated by the failure of science teachers at all levels of the Jamaican education system



to incorporate the features of the register of science with the students' social and cultural realities.

In such a situation, it is imperative that science teachers study the textbook to find out how difficult it is for their students and adopt a more sensitive approach when introducing scientific lexis in classroom discussions. Kearsy (1998) suggests that unfamiliar words should be explained and emphasised on their first appearance and should be included in the glossary of the students' textbook.

With respect to the organisation of the science textbook, some of the students taking part in the study were complimentary about the activity sheets appearing at regular intervals in the textbook. Kearsy (1998), in his assessment of the accessibility of science textbooks to bilingual students in the UK, found that although complementary activity sheets can be useful for learners to evaluate their own progress, they may encourage 'short burst' reading. He warns that 'short burst' reading is unlikely to provide students with adequate means for developing critical reflective or evaluative approaches to reading. Some of the participants, similar to their peers who took part in the questionnaires, criticised the science textbook for its lack of logical structure and for a lack of linkage between text and related pictures. For example, Kameka commented that "I don't really like the way the chapters are organised. They could be better set out to show how different processes are connected to each other". When asked to give an example, Kameka said "the heart and the lungs are dealt with in two different sections and the book doesn't show how they are connected properly". In relation to the lack of linkage between the text and the related pictures, one student (Jane) simply said "sometimes the pictures are not related to what I am reading, the pictures could be replaced with more useful diagrams".

In so far as the distribution of communicative loads is concerned, there seems little doubt that language occupies a central, if not the dominant, role in the Jamaican science classroom. This, however, is not unique to the Jamaican classroom context, since alongside others, Kress (2014), in his assessment of the interface between language and other modalities of communication, has called for broader approaches to science teaching and learning that integrates what Lemke refers to as 'science talk' with modes such as gestures, images and models.

While many of the participants' responses were largely focussed on the role played by language in the interactive processes of classroom teaching and learning, a few of the responses highlighted the multimodal nature of the science classroom. For instances, one student (Nyree) commented that she finds it easier to understand science instructions when her teacher uses three-dimensional models. This was a welcome perspective, since researchers such as Kress (2010, 2014) have consistently argued that linguistics descriptions are only partial accounts of the interactive processes of classroom teaching and learning, and thus must involve all representational and communicative resources available to teachers and learners.

## **7.8 Teacher interview analysis**

### *7.8.1 Piloting of the research instrument*

Before conducting the main body of research, a small-scale exploratory pilot study was conducted in the forms of Skype and FaceTime interviews. These methods were chosen as they were more cost- and time-effective than travelling to Jamaica to carry out face-to-face pilot interviews. The aim of the pilot was to develop the interview schedule for the main study and to gain an understanding of the context under investigation, as a preparation for the main study. Additionally, the recorded material provided preliminary data on the effectiveness of the proposed method of data collection.

The interview guides were piloted with a selected group of participants, namely two female and one male science teachers. Both female teachers work in a traditional high and a technical high school similar to the ones used in this study. The male teacher taught for 20 years in a Jamaican secondary school, but relocated to New York in 2015, where he now lives and works. All three participants were teachers I knew from my professional background, and they agreed to be interviewed after being briefed on the context and purpose of the study. As we all lived in different countries we concluded that it would be more feasible to conduct Skype and FaceTime interviews.

During the pilot phase, some of the questions were identified as unclear and ambiguous and were removed from the final draft. No additional questions were added; however, a few questions were rephrased and softened in tone. For example, "How do you normally introduced text to your class?" was rephrased to "When you are teaching a topic from your

textbook, how do you normally introduce text to your class?”. This question needed rephrasing because all three teachers who participated in the pilot of the instrument complained that they were not quite sure what I was asking.

The pilot study was also valuable in helping me to develop my interviewing skills, as I understood better how to pose the questions and how to ask follow-up ones, making sure there was a flow in the way the questions were asked. It also helped me gain confidence in my ability as an interviewer. When I did the first pilot interview I felt anxious and I found it very hard to ask questions and keep a flow in the conversation. However, I overcame this during the following pilot interviews. I did not face any other major problems thereafter and so my interview schedule was not altered after the pilot study. These three interviews were not included in my final sample.

### *7.8.2 The interviewing process*

Most of the interviews were carried out at the participants’ schools, in the science prep-rooms, where we could be alone and where it was quiet. A few of the teachers were also interviewed in the head teacher’s office, without the presence of the head teacher, because in the staff rooms there were a lot of people (other teachers, students, parents) and along with the issue of noise, there could also be an issue of confidentiality and of the teachers expressing themselves openly. Although the teachers were not in their own office, they did not seem to feel uncomfortable, as they seemed willing to talk and express their views. All the interviews lasted for about thirty to forty minutes and were recorded using a digital recorder. I allowed the participants to choose the time of the day they wanted to be interviewed. The majority of the teachers chose a free period between their classes or after the school day was over.

Teachers were told that could speak either JC or JSE if they so wished. Bryman and Bell (2007) observed that if the respondents are able to speak in their own language, they can express themselves in a more precise way, the answers will be richer and the respondents will feel more relaxed. All the teachers chose to speak JSE, even though many participants moved from JSE to JC if s/he failed to find the right phrase to express an idea or phenomenon.

As was the case with the students’ focus groups, the interviews were audio recorded, as recordings have the advantage of giving an accurate summary of the interviews, as well as

capturing the speed of speech, tone, and voice pitch of the participants. These data proved very useful in the analysis. Furthermore, the recordings allowed me to transcribe the participants' responses, which were essential for full analysis and including relevant quotations below.

Although I developed a good rapport with most of the participants and obtained rich and fruitful data, some of the interviews proved problematic for several reasons. First, a few of the participants were suspicious and unwilling to be recorded while some others were reticent to speak openly because they were afraid of who might listen to the recording. Indeed, one teacher explained that she did not like the idea of her voice being listened to in case she said something silly or did not give the correct answers. In similar vein, another teacher asked the following: "I have read the information sheet and would be happy to help but can you do it without recording me? Will the head teacher listen to the recordings? Can't you just take notes? What if I don't say what you want me to?" In such cases, I reassured them that everything in the interview would be kept strictly confidential and that they and their respective schools would never be identified by name or in any way that might allow others to identify them. It is important to note, that all the above concerns were outlined on the participant's information sheets. However, it was worthwhile to reassure the teachers in order to gain their trust.

Secondly, some of the participants commented that they were frustrated with the language debate and were, what I can only describe as, hostile and defensive to any questions that were related to the use of JC in science instruction. For example, Irene said: "I am willing to participate as long as you don't ask me any nonsense about using patwa [JC] in my lessons". I informed her that I was interested to hear her views on all aspects of language usage in science discourse, including the use of JC. After which, she respectfully withdrew her participation from the study.

Thirdly, science teachers have their own priorities and an appointment would easily be jeopardised by the many issues needing attention during each day. I felt that it was unfair to ask participants to give up time outside school hours, but meeting in school was subject to interruptions. Time just before or just after school, or free gaps in their daily programmes seemed a reasonable request. In the end, I managed to interview all of the teachers who had agreed to be interviewed in spite of the many crises that were on-going while I was present

(e.g. one head of science, who was also acting vice principal, was informed that a student had a high fever, in a period when there was great panic about the measles virus, and she had to call the child's parents to come and pick her up). There were only a couple of interruptions during one of the interviews, which suggested that my participants saw the interviews as important and had made arrangements not to be disturbed, as far as possible.

## **7.9 Grounded theory**

As mentioned previously (Chapter 1), there is limited research on the perceptions held by teachers on the accessibility of textbooks in school science. I was unable to find any research which specifically explores how Jamaican science teachers perceive the role that language plays in science discourse and instructions, and how they address language demands of science in their classroom. Hence, the claim could be made that the theoretical foundation on which to base further research in this area is limited.

Grounded theory is known to work well with research studies which are intent on exploring new terrains in which contextualised theory emerges from the empirical data. This is the main reason why I chose this approach. The method of analysis described in this section has been discussed extensively elsewhere in this study (see Section 6.13) but it is worth providing examples of the initial and final coding framework used in the data generated from the actual interviews. These examples are presented as Tables 7.3 and 7.4.

**Table 7.3 Example of the initial coding framework**

Interview transcript	Initial coding framework
<p><b>Interviewer:</b> Let’s talk about textbook usage – how often do you use your textbook? How do you use them?</p> <p><b>Respondent:</b> I use science textbook as a source of reinforcement. What I tend to do more often is condense the information. The science textbook has good diagrams in it that relate well. So we use it when we want to relate them to the diagrams. Textbooks are also good for active reading and reading checks. Also, sometimes to have them look at lab instructions, so for instance, if an example of a lab is given in a textbook then students do work in groups because there is usually not enough equipment and materials for them to use as individuals students so having them in a group ... having the group read the instructions ... having different students read aloud ... discussions about what we have read ...</p> <p><b>Interviewer:</b> Do you think all the textbooks are written for these students to understand?</p> <p><b>Respondent:</b> No. They are not, because some terms you know because of the Standard English going through out some of the students especially in Jamaica will not understand ... the language of science by its very nature can be very complex ... what makes it more difficult for students to understand is that when you think of their first language, the roots and origins of their words differ significantly from the roots and origins of the words that are in the science books.</p>	<p>Use of textbook</p> <p>Use of diagrams Active reading Lab instructions Group work Lack of equipment Group discussion Language barriers</p> <p>Language of science</p> <p>Causes of language difficulties</p>

**Table 7.4 Final coding framework after reduction of the categories in the initial coding framework**

Final coding framework	Initial coding framework
Language attitudes	<ul style="list-style-type: none"> <li>• Perceptions of the role of JC as the medium of science instruction</li> <li>• Attitude towards the use of JC</li> <li>• Attitude towards the use of JSE</li> </ul>
Code-switching and Translanguaging	<ul style="list-style-type: none"> <li>• Use of code-switching</li> <li>• Attitude towards code-switching</li> <li>• Use of translanguaging</li> </ul>
Language in science learning	<ul style="list-style-type: none"> <li>• Perceptions of the role of language in science learning</li> <li>• Perceptions of the register of science</li> <li>• Language-related challenges identified by teachers</li> <li>• Language in scientific discourse</li> </ul>
Science textbook usage	<ul style="list-style-type: none"> <li>• Perceptions of science textbooks</li> <li>• Frequency of use</li> <li>• Ways in which textbooks are used</li> </ul>

## 7.10 The findings

### 7.10.1 *Language attitudes*

There is substantial evidence from the interview data to suggest that teachers held ambivalent attitudes to language use in science classrooms across the five school types investigated in the study. These findings are triangulated with the ones that emerged from the students' group discussions. Many of the science teachers who participated in the study vehemently rejected the notion of JC as the medium of instruction on the basis that it is a 'bastardised' language that does not have a role in education. They felt that the education system is best served by teaching students JSE, using it as a medium for teaching scientific literacy and, as well, using it as the sole medium of instruction. In this respect, the teachers' views serve to reproduce the prevailing linguistic status quo of the dominant class and the wider society. Consequently, no effort has been made to promote language consciousness amongst the populace. Devonish (2004) observed that a significant majority of the Jamaican population has adopted the linguistic order and frown upon the use of JC (in any form), particularly in the educational system. Such reservations were more prominent in the private and traditional high schools (the more academically inclined schools), where teachers were vehemently opposed to the use of JC in education. Indeed, one teacher (Jill) expressed anger and outrage that researchers, such as myself, seem to have an obsession with this "gibberish 'palawala' nonsense". The education system, she continued, "would be better served if more time was invested in teaching students to write proper English".

Still, another teacher (Gail) asserted that she "didn't have much time to entertain this 'patwa' foolishness." Such derogatory views are by no means surprising, since they are in line with the findings from the students' interviews, and support the conclusions drawn by researchers such as Bryan (2010) and Simmons-McDonald (1994, 2006). These authors have drawn specific attention to some of the pertinent issues surrounding the negative image of JC and the factors that have hampered the integration of the language in the education domain.

The perception that JC is a deviant dialect of Standard English and therefore inappropriate for the purposes of education was the prevalent position for most teachers. Take, for instance, the following comment by Jasmine, a teacher at a traditional high school, when she was asked about the use of JC for science instruction: "ha ha [laugh out loud], teach JSE to our students.

JC is bad language; it serves no purpose beyond the airport". Jasmine's views found support from one of her colleagues, Christine:

It's absurd to use Creole in science classes, primarily because it is quite unfit to raise the educational level, Creole is too primitive, my students would be unable to read and write it. Furthermore, Creole is not even a language. Is it is a local dialect. Until our language [JC] is accepted at the level of other languages, where other people in other country can study it [pause], then you can say it really is a true language. At the moment, it doesn't have all the different tenets that make a language a language. So, in that sense it could not be used for instructions. It is better to use English only, which is our standard language. Right? You see, we all can talk it but we can't even write it [in reference to JC]. We don't even know the lexicon for it. Everybody have their different version. So, it's not really a language in the true sense.

Another teacher (Janet), weighing in on the issue, rejected the use of JC as the main vehicle of communication in the class as she believes that the problem of English proficiency was as result of poor resources and inadequate professional development of teachers. She believed that stronger emphasis should be placed on the teaching of English and in helping students to move from using the native language to understanding the rules of JSE. In so doing, students, she contended, will become more adept at using it. According to Janet, using JC as the medium of instruction would be akin to saying, "we have failed to impart our accepted language of English, so we are giving up. This one can't work, so let us find another one that can work".

Further in the interview Janet attempted to make an interesting link between students' poor English language proficiency and teacher recruitment:

We have to look at the broader picture. For example, we need to look at the kind of teachers that we are attracting to the classroom. Most of the brighter set of students don't go to teachers' colleges. So, we need to look at incentives for persons who are teaching Maths, Science and the languages to keep them in the classrooms. Because you are going to lose them to England, and you a go lose them to Canada, and you will lose dem to the Middle East or where ever. So, look at those areas first, you understand. You will see where the teachers' colleges are advertising for core courses that you are going to teach and you need a grade 1 pass alright? But what they do



when their quota is not filled? When those getting grade 1 in Maths, Physics and Chemistry, History, Biology and Add Maths gone do to do medicine. What the teachers' colleges dem do? They go for the second-tier students and, those students are normally the weaker students. Those students are normally the ones who come out and teach so we have to look at all that and so it is not just one single 'de ge de ge' factor, you understand. De ge de ge factor being a JC word which means only one [laugh out loud]. We have to look at all the factors and then we can try and fix them over time, cause it nah go happen overnight, before we even can start to say how we a go put the bible in a Creole and text book in Creole or any other text book for that matter. When we start doing that now how is it going to look? We [Jamaica] too small for this we can't compete by ourselves to be having Creole, you understand?

The teachers' dissatisfaction towards questions related to the use of JC as the medium of instructions in classrooms was not conveyed solely through dialogue but by non-verbal signals, what Rickford and Rickford (1976) described as 'kinesic makers', such as body language, the use of the 'eye-cutting' and 'teeth-kissing'. In Jamaican communities, the act of teeth kissing is a ubiquitous practise, used to express condemnation or displeasure with a situation or person by making a sound through the act of sucking air through one's teeth (Rickford & Rickford, 1976). Patrick and Figueroa (2002) point out that sounds of greater intensity are understood as expressing stronger or more overt feeling of contempt or annoyance.

Similarly, Rickford and Rickford (1976) describe eye-cutting as a visual gesture initiated by making eye contact with someone or something, then quickly closing one's eyes and turning or tossing them to one side. Scholars such as Patrick and Figueroa (2002) and Rickford and Rickford (2007) have observed that in Jamaica, as is the case for the rest of the Anglophone Caribbean, the eye-cutting gesture denotes resentment, irritation, intolerance or a general denunciation of the person at whom it is directed. My own observation of eye-cutting in the Jamaican context suggests that it is performed more frequently by women than by men.

During the interviews, I noted several occasions when both these gestures were used. For instance, one teacher (Shariska) showed her irritation by kissing her teeth when she was asked if English proficiency was important for success in science. Shariska responded: "Very much so". When pressed further, she replied sharply:

How could it not be? [teeth-kissing] The content in the textbook is in Standard English, so if we are going to have textbooks written in Standard English, why wouldn't we not teach in Standard English? Can you just imagine a textbook, a science textbook or whatever subject, and you have in the corner, mi sey you mustn't nyam inna the lab [you should not eat in the lab] or mi sey you mustn't pipette wid you mouth? How would that get across to the children? [eye-cutting followed by teeth-kissing]. That just doesn't make sense.

The message from the above quotation is explicit and unequivocal – a clear rejection of the use of JC as a medium of instruction in science education. Undoubtedly, Shariska's comments ignore the value of students' home language in providing language-rich and contextualised learning experiences. Moreover, they reveal the ambiguity that still exists about JC. On the one hand, JC is lauded by many as the language of cultural vitality, while at the same time its regular use in relatively prestigious domains is not encouraged. Perhaps such a prevailing negative attitude towards JC is a result of the inability of experts in the field adequately to demonstrate the positive impact of the use of the native language on learning outcomes (Simmons-McDonald, 2006).

Interestingly, as was the case with the interviewed students, none of the teachers commented on the African linguistics retentions in JC. This observation can be explained by offering two separate but potentially complementary perspectives. First, in spite of the economic and social development on the African continent, it is perhaps fair to say that many Jamaicans still hold negative perceptions towards Africa. From this viewpoint, the continent is deemed as a down-trodden place of mishaps and has-beens, a place of disease, poverty and chaos, and a place devoid of history or future (Araya, 2008). Indeed, it is not unusual to hear Africa being depicted as "the dark continent" with dark tales of violence and hostilities. Such perceptions have been shaped not only by historical context but by hegemonic practices propagated by the media which consistently, without providing context or balance, portray the continent of Africa in the past as primitive and Africa in the present as a problem (Lewin, 2009). Such stereotypes and generalisations still resonate with many Jamaicans, who consequently reject or deny any cultural or linguistic links to the African continent.

There is another position that can also explain the above-mentioned observation, one which locates itself in psychology and the discourse of colonialism. What is at issue here is the

acknowledgement of the critical legacy of colonialism on how formerly colonised people acquire knowledge and understand their history, in societies which explicitly promote Eurocentric epistemology, ontology, and hegemonic ideologies. Also, related to this position is a recognition that colonialism was not satisfied merely with the social and political subjugation of colonial subjects but also internally and psychologically, what the postcolonial writer Robert Young (2003) describes as a kind of ‘metempsychosis’ in which “their desires have been changed into another form, carried across into the desire for whiteness” (p. 114). In this formulation, colonial epistemic and ontological biases that promote the validation of a European monopoly of power and superiority while portraying the people of the colonised world as inferior, childlike, and requiring the paternal rule of the west are reinforced. Such colonial ideologies have unfortunately lingered in the identity of some Jamaican people and contribute to the negative perception of Creole languages.

On another level, several teachers endorsed the use of JC as the medium of science instructions, albeit in a restricted context. For example, Bibi commented:

Personally [pause] I think it should be present in the text book and it should be present in the syllabus. Why? [pause] Because, as I have said before, many times you are trying to explain something to the students and they will not totally get it using the English only. But, if you use the patwa they can relate to those words. You might say this is what the word is in patwa and this is it in English. They will better understand how to use the words when they are writing. For example, in patwa one might say “Di day a gwan good.” You can tell them that in English it is “This is a good day “. In this way the students will be able to relate their patwa to the English to help them read better. Also, the part of the book that says ‘vocabulary’ or ‘key terms’ should have the patwa words beside the English words, so they can take these words from the classroom and to actually practice them back out there in the wider society.

Implicit in Bibi’s observation is a view that promotes the use of both languages in science instructions and which mirrors the aims of the Bilingual Education Project (2004)<sup>16</sup>. In my view, there is considerable merit for this position since teaching students in both JC and JSE will valorise their first language (for many, JC is their first language), while providing

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<sup>16</sup> The Bilingual Education Project (2004) aims to provide answers for a new framework strategy for the official use of both languages in primary school.

scaffolding which will make the acquisition and mastery of JSE much more attainable. However, this model, I would hasten to add, could only succeed if Jamaica moves to a bilingual context where JSE and JC are given equal status. In this way, students gain English language proficiency without shedding their cultural identities in the process. Such a model also finds considerable support in second language theory and research (see, for example, Craig, 1999; Pollard, 1998) and is an idea that is relevant in the Jamaican context where “vernacular-speaking learners of English need a strong conscious awareness of the formal characteristics of both their own language and the English they are attempting to learn” (Craig, 1999, p. 7).

In similar vein, Aldinero supported the use of JC but with some reservation:

The students like when I use Creole because using it makes the lessons interesting. Speaking Creole can better bring across a point with more clarity and understanding. However, at each endpoint of a statement I translate into JSE.

Embedded within Aldinero’s description is a model that acknowledges the positive impact of the native language on science learning while at the same time foregrounding the significance of Jamaica Standard English as the language of development, modernization, and scientific and technological advances. At a surface level, this a welcome model as it encourages the development of bi-literacy and bilingualism, raises teachers’ awareness of the various linguistic dimensions of science-related fields, and promotes a formulation of classroom practices that are both academically rigorous and equitable for all students. However, such a description perpetuates the hegemony of JSE, since both languages do not occupy a similar status in the classroom context.

Throughout the interviews, it was evident that JSE held a hegemonic position in the science classroom. It is probably fair to say that most teachers considered it as a language which students are expected to internalise and accept as exigent and indisputable. This was apparent from the teachers’ response to a question about which language they use most often in their teaching. Unsurprisingly, JSE was reported as the language used most of the time and one that seemed important to the teachers. Indeed, the phrase ‘all the time’ was repeated continually in relation to JSE. For example, Gail said: “I try my best to use Standard English all the time. If the students say something in patwa, I get them to repeat it in English”, while Joan asserted: “I use English in every situation and every context of my teaching”.

Others did not go so far but employed words such as “frequently”, “often”, “regularly”, and “normally” to describe their use of JSE for science instructions and discourse.

### 7.10.2 *Code-switching and translanguaging*

As has been shown (Chapter 2), JSE and JC complement each other in the Jamaican environment and many speakers can switch their speech as occasions demand. Writing about language use in Jamaica, Vilma Pollard (1998) points out that code-switching is an integral part of the behaviour of the Jamaican speaker, as of speakers in most bilingual and plurilingual societies. Moreover, several scholars have pointed to the prevalence of code-switching in many *Jamaican* schools (see, for example, Bryan, 2010; Simmon-McDonald, 1996). These researches have also considered how the practice of alternating between two languages in oral interaction, with special reference to JSE and JC, can be positively used in educational settings. At the same time, writers such as Bryan and Burnette (2006) have reported that many teachers perceive code-switching as having a negative effective on students’ language development, especially on their reading and writing skills. Unsurprisingly, the misconception that code-switching was an indicator of a person’s incomplete knowledge or incompetency in one language found popular support amongst the participants in Bryan and Burnette (2006) study.

The notion of translanguaging was also discussed in Chapter 2, with reference to a pedagogical practice which switches the language mode in bilingual classrooms (see Baker, 2001). Crucially, translanguaging theory and pedagogy challenges traditional understanding of bilingualism. Rather than viewing the two languages as constituting two separate linguistic systems, the term translanguaging assumes that they have a unitary system (see Garcia & Kleyn, 2016). Taken from this point of view, the focus is placed on communication rather than on languages (Garcia, 2009). Thus, one language is not promoted above the other and bilingual students are free to use elements of each language (JSE and JC) to understand their social realities.

Several scholars have suggested that there are epistemological differences between the theoretical positioning of translanguaging and code-switching. For example, Garcia and Kleyn (2016) argue that whilst code-switching describes the linguistic actions of bilinguals when they alternate between two or more named languages, translanguaging refers to “the

deployment of a speaker's full linguistic repertoire, which does not in any way correspond to the socially and politically defined boundaries of named languages" (p. 14).

Additionally, Garcia (2009) observed that translanguaging differs from code-switching in that it combines two or more languages in a more systematic way within the same learning activity. For example, science discussions can take place in one language and writing in another. In this way, students are able to incorporate the discursive practices of the science classroom into their own linguistic repertoire and are allowed to use them freely. In such classrooms, instructions are more easily conveyed to the bilingual learner and so further increase students' participation in classroom activities.

In this study, I have used the term translanguaging to refer to the pedagogy practices of Jamaican science teachers when JSE and JC are not viewed as separate linguistic systems but are used strategically as linguistic resources in order to construct meaning. In so doing, both languages are acknowledged as having social realities but not linguistic realities (Garcia & Kleyn, 2016). In other words, there are no linguistic features in 'nyam' and 'eat' that makes one JC and the other JSE. Similarly, I have used code-switching to include situations in which the informants alternate between JSE and JC during our conversations. In this context of this research, therefore, it is instructive to consider how Jamaican science teachers use translanguaging as a linguistic resource in their classroom and their attitude to and use of code-switching.

During the interviews, code-switching was evident when a teacher failed to find the right phrase in JSE or for the purposes of emphasis. Significantly, most of the teachers seemed unaware that their speech was then not JSE. Take, for example, the following statement made by Bibi who earlier in the interview suggested that JC had no place in formal situations: "the science textbook is quite daunting for di [the] students dem [them] in the lower years" and another teacher (Marie) who said: "henglish is important if dem want to study in America or England". Still another teacher (John) when asked to explain the main purpose of science teaching replied:

Well, mi would a sey, de main purpose of science teaching is not only fi educate de yute dem but also to stimulate the creative aspects of dem mind. You know wey mi mean? You haffi kinda instil a level of curiosity in dem, so that they want to find out why things happen the way they do or why different reactions take place. What are

the problems that are occurring in the environment and what are the solutions that can be ascertain to deal with those problems?

In the above examples, it would appear that the lexical relationship between JSE and JC serves to mask the differences of pronunciation, syntax and grammar. Thus, the teachers switched effortlessly between the two without apparently being able to recognise these differences. Code-switching used in this way may be seen by some as a 'corrupted or ill-mannered' behaviour, especially among middle-or upper-class speakers for whom JSE purity is an ideal (Pollard, 1998).

Another possible reason that may explain the teachers' use of code-switching in the above examples is one that Crystal (1997) describes as a speaker's 'language deficiency'. Viewed from this perspective, Crystal (1997) argued that a bilingual speaker may switch between languages if s/he is unable to express him/herself in one language. Indeed, such a practice is a common feature in many normal everyday conversations, especially when the speaker is upset (Skiba, 1997). Interestingly, Moore (2002) counters Crystal's argument asserting that code-switching does not necessarily demonstrate incompetence in one language but instead requires higher level thinking of grammars and structures of both languages that monolingual speakers do not have. Although the data may suggest that the interviewed teachers use code-switching to compensate for their lack of proficiency in JSE, the evidence was by no means conclusive. There is a need for further research in this area.

Implicit in many of the teachers' responses, when they were asked to explain how and when they use JSE and JC, is a pedagogic practice that underpins some general tenets of translanguaging as described by writers such as Canagarajah (2011) and Garcia and Wei (2014). In such a model, the teachers used resources from both JSE and JC to communicate more effectively with their students. Take, for instance, the following quotation from Carol:

Basically, for me, I always start with the standard English, but as you go throughout the lesson you realize you are losing some students, so because we are all familiar with the JC, sometimes you have to pitch in a little bit here and there, where you do a little role play for them to get the fully understanding and for you to engage everybody. To make sure you have everyone's attention you use the Creole but we use both Standard English and Creole throughout.

And another from Jasmine:

I use JC especially if I am bringing about practical examples based on certain topic or concepts. In these cases, I would bring my own experience and I would divert into the dialect. You know, using the dialect is like an ice breaker, it make them feel a bit more comfortable in the classroom. It initiate their curiosity and their wanting to answer a question. They won't be afraid to answer a question and think wey mi ago sey [what am I going to say] in front a sir afta mi caan [because I can't] talk English good. You know they are able to express themselves freely. It is up to the teacher now to cultivate and then mould that expression in the right way so when the child get a question he is able to formulate that question in a proper sentence in the English language.

Jasmine further acknowledged that the use of English is only effective because students are afforded a model and as a result they can produce the required standard variety in their writing:

English only can be good providing you have a group of students who can follow and who can be with you. If using English only is going to put some of the students at a disadvantage you will have to know how to help the students to understand what you trying to explain. But using English only is effective because the children model what they hear. So, you as the teacher and you use English and use it correctly the children hear it and they are able to pick it up and are able to model it. There is a disadvantage in that if there are students in your class who are not comfortable with the language you lose with them and they are not able to keep up with what you are saying. You are not communicating with them, so then you will have to switch [to Creole] to help that child.

A further perspective was provided by another teacher (Peter):

In my teaching because the focus is on the Standard English, I try to present the information from that perspective first. However, I read the faces and if I see them experiencing a certain amount of difficulty, I go into the JC and then bring then bring it back to the standard.

Embedded in the teachers' description of language usage in their classroom is a conception which Wei (2011) describes as a 'translanguaging space' – a space in which bilinguals or multilingual language users bring together their linguistic resources in a socio-interactional



context. Within this space, the teachers help the students to bring together different dimensions of their cultural experiences and linguistic resources to promote scientific understanding. In this sense, therefore, it seems clear that such pedagogical practices are transformative for the Jamaican education system as a whole, when one considers that both the students and their teachers share the same language background. In this way, teachers can help their students to draw from their entire language repertoire to organise and mediate processes of understanding.

### *7.10.3 Language in science learning*

As we have seen from the Cloze test data (Chapter 4) and the students' questionnaire responses (Chapter 5) the language used to construct scientific knowledge in science textbooks and science discourse was identified as a major source of difficulty for many students, especially for the exclusively Creole-speaking children. Many students reported that they felt threatened by the language used to communicate science concepts, which negatively impacted their learning. At the same time, many teachers also reported on the teacher questionnaire that their students experienced problems in understanding scientific language (see Chapter 4). Many of these results parallel recent findings on language and science learning (Hand et al, 2010). Given the growing significance of this issue to science learning, it is important to gain a deeper understanding of teachers' perceptions of language in science learning. More specifically, it is important to consider how teachers perceive the role of language in science classrooms and the language challenges faced by their students in gaining scientific understanding.

The interview results indicate that the teachers were united in the belief that the language of science classroom discourse and science textbooks posed significant barriers to the learning of science. Indeed, for most teachers, it would be reasonable to assume that they viewed language in science as one of the most challenging demands on their students' science learning. This became apparent in the teachers' descriptions of the problems that their students encountered during science lessons. For example, Marie explained that her students were from a low attaining group and she believes that they are exposed too quickly to large numbers of scientific terms, which embody large and complex concepts. Most often these terms are polysyllabic words, which her mainly Creole speaking students find difficult to grasp or feel confident in using. Marie continued:

I really doubt if these children can use the textbook on their own, that's why I try to break it [the language] down as simple as possible. I would have to say the language is the greatest concern that I have. Even when I simplify the language [from the textbook] and write it on the board it still requires some explanation. I believe that what is written in the textbook is too difficult for them to make sense of by themselves.

Another teacher (Natalie) also highlighted further problems relating to spelling and pronunciations of these words:

Whenever I ask them to read they would hesitate when they get to the technical words and a great amount of time is spent trying to pronounce and spell them. Also, sometimes when you asked them to do homework or prepare ahead before you move on to a particular topic, they would come back the next class and when you are trying to brainstorm or just trying to find out how much they have grasped, you would suddenly realise, that they are struggling to understand specific terms that are unique to science. They would say "Miss, I saw this word and I don't know what it means" or "Miss wi read it but wi no really understand".

Marie's views were supported by all the other teachers in the junior high, technical high and upgraded high schools, albeit the severity of the challenges varied across students of different performance levels.

Another major problem identified from the teachers' responses lies not with the novelty of scientific words but the ordinary everyday words that have different meanings in JSE and JC. Moreover, some of these words may have science-specific meanings that are different from or more narrowly defined than their everyday meanings. For example, words such as *clot* and *salt* have specific meaning in science discursive practice and are clearly part of the lexicon but both have different meanings in JSE and JC. In JC *clot* means to 'hit or strike', but in everyday JSE, it is used to refer to someone who does something very silly, while in the language of lexis, it refers to a thick mass of coagulated liquid. In similar vein, the word *salt* in the everyday Jamaican context denotes 'empty-handed' or 'low funds' while when used in the lexicon and discourse of science it refers to an ionic compound that results from the neutralisation reaction of an acid and base. A further example is *belly* which in JSE is a synonym for the stomach but in JC can refer to pregnancy. In such a situation, the Creole speaker has to

internalise different meanings of a given concept or word, none of which is the same as any JC meaning. This poses problems for the learner as they will need to code-switch from everyday uses of language to the language of science, as one teacher (Carol) explains:

I can't speak for everyone but a major problem for my students is dealing with words that have specific meanings in science and a different meaning in everyday use. Take for example, the word 'power'. You know power has a different meaning in Jamaica to that use in science and no matter how I try to explain it to the students they always seem to write the Jamaican meaning in the test.

Carol's view was supported by Jasmine from the same school who asserted:

Most times students use the science vocabulary inappropriately. They often think in layman terms, so when you have words that have meanings in science that are different from their familiar meanings they will always be thinking in layman terms and most of the times it is not correct.

These results parallel the findings of researchers such as Fang (2006), Osborne and Wellington (2001) and Tan and Soong (2006), and further supports the notion that the Creole speaking child needs first to encounter and experience science in their own language before having learning imposed upon them via codified discourse that is the established language of science and scientists. Mervyn Alleyne (1983) points out that JC shows a preference for definitional labelling over the purely arbitrary labelling that is supposed to be the cornerstone of the symbolic system that language is. In other words, JC provides a more direct link between the linguistic sign and the concept. So, to the Creole-speaking child *nostril* is a purely arbitrary sign to refer to either of two external openings of the nasal cavity in vertebrates that admit air to the lungs and smells to the olfactory nerves. *Nose hole* is much less arbitrary. Likewise, *saliva* which in the English lexicon refers to the thing produced by certain glands to aid mastication and digestion is a more arbitrary sign than the Creole equivalent *mouth water*.

From this perspective, teachers could encourage pupils to use more precise Creole words or phrases compared to the more arbitrary science vocabulary to express their scientific ideas. For example, when discussing human anatomy pupils should be encouraged to use terms such as *seed bag* (scrotum), *knee cup* (patella), *seed* (testicle), *maw* (stomach), *nose hole* (nostril), *tripe* (small intestine), and *belly button* (umbilicus). Similarly, a lesson on the plants and animals found in Jamaica could incorporate words from the Creole lexicon that the pupils are

most familiar with. For instance, students can use Creole words such as *shoe-black* flower (hibiscus), the *bunga-bee* (bumble-bee), the *single-bible* or *sintle-bible* (*Aloe vera* plant), or the *alligator pear* (avocado) when discussing local fauna and flora. Such a model provides a rich resource of scientific terms, which can act as a scaffolding before students progressively move to the more arbitrary vocabulary in learning science. Such a common-sense approach will not run the risk of “stranding students in their own words” (Halliday & Martin, 2003, p. 170) but will provide a platform for moving students from their everyday ways of talking, thinking and doing to becoming competent in the ways of scientific thinking and scientific discourse.

A major concern for many of the interviewed teachers was with the syntax of JSE. As Christine, a science and English language teacher at a technical school, asserts:

The students in my class really struggle with reading and writing. I would guess that one reason for this is because they are mainly Creole speakers. So, when it comes to writing things like experiments in [Jamaican Standard] English they struggle in expressing their understanding. It is really difficult for them to put words in a coherent sentence.

One teacher, Rose questioned the use of the passive voice in scientific writing. She argued that the use of the passive voice makes the students’ science report obscure and dull, and was not reflective of writings in most international science journals. She vehemently argued against the mandatory reporting of laboratory experiments by the Caribbean Examination Board (CXC) in the passive form, suggesting that removing the ‘scientist’ from the report will not necessarily increase objectivity. Rose believed that the reliability and trustworthiness of the data was more important than the language form that it is written in. She went on to suggest that although the passive voice has its place in scientific writing, students should be given the choice to use a mix of both active and passive voices in reporting experimental findings. This position is supported by writers such as Alvin (2014).

For some of the participants there was also an issue with JC’s lack of words, expressions, and modes of meaning for communicating science. For example, one teacher (Jeanne) alluded to this when she asserted that:

The language of science by its very nature can be very complex and what makes it more difficult for students to understand is that when you think of their first language,

the roots and origins of their words differ significantly from the roots and origins of the words that are in the science books. So, for instance, if you were learning Spanish some of the root words for the Spanish words you are learning would be similar to English and so it might be a little clearer if you have mastery of English ... mastery of the JC does not mean you understand the etymology of the word that you are looking at in the science book, so when I go to class and I say what is a polymer? Polymers means many parts, so students who have mastered English would probably have met polygamy or some other word or that that uses the same pretext and it would make sense and they would be able to relate. But when you don't know English, when you have not mastered English and your first and mastered language is JC you can't make those kind of references and then it makes it more difficult for you to understand science, science jargon also. What I find is that because a lot of the texts are not very concise, then you find that they trying to explain is too wordy and the wordiness of it is what really put the children off.

#### *7.10.4 Science textbook usage*

The data concerning the frequency of use of science textbooks were consistent with the responses reported in the teacher questionnaire analysis and further reinforced Yager's (1983) assertion that the selection of a textbook is one of the science teacher's most important instructional decisions. During the interviews, many of the teachers reported that they frequently used science textbooks in classroom discourse and instructions. Indeed, it would appear that for these teachers the textbook was the 'tool of their trade' (Kamm & Taylor, 1966). Take, for instance, Jeanne's comment when she was asked how often she used science textbook in her teaching: "Science text books are heavily used, it is almost unheard of to go to class without somehow incorporating the use of the textbooks in your lesson plan". Another teacher (Samuel) replied:

Very often, because you see the children get a book from the ministry under the rental program and I ensure that they utilize it. So, every week if it's even once, let's say I meet a class three times per week, I ensure they use the book at least twice ... I assign them areas in their textbooks to use.

Jeanne also offered a possible explanation for the high dependency on textbooks in Jamaican schools.

... there are other resources which could I use, for instance, students could do a lot more research online. But then the absence of computer from the hands of every child is an issue and one has to establish some amount of equality in the classroom in terms of student exposure. Putting students in groups and sharing computers in a computer lab doesn't really work. Furthermore, that is not something that can be done every day because a computer lab is still quite novel to Jamaica and I like to say it is properly protected by the Praetorian Guard.

Jeanne's observations are consistent with Soyibo (1996) who pointed to the lack of laboratory facilities as an underlying factor for the heavy reliance on science textbooks.

The interview data also revealed a relationship between the teaching strategies employed and the use of science textbooks. For example, when they were asked the question "In what situation do you normally use your textbook?", one teacher (Jeanne) said:

I use textbooks for active reading and reading checks. Sometimes to have them look at lab instructions. So, for instance, if an example of a lab is given in a textbook then students do work in groups because there is usually not enough equipment and materials for them to use as individual students. So, I sometimes put them in a group and let them read the instructions or sometimes different students read aloud. Sometimes, I might ask them to read the instructions silently and then have a discussion about what they have read.

Along much the same lines another teacher (Roy) replied:

I use science textbook as a source of reinforcement. What I tend to do more often is condense the information. Ninety percent of the students have textbooks, but what I have notice when I tell them to refer to their textbook to a particular diagram, they would say "sir mi leave it" or "sir mi neva carry". Some will even say "sir dem book deh too heavy sir, mi can manage it". And even with the cd attached to it, they just see it as something to be on the shelf at home. They are more likely to bring around the cd than the text book.

Still another (Carol) answered:

The science textbook has very good diagrams, so we have diagrams in it that relate well. So, you will get diagrams of the digestive system; you will get like methods of

fertilization; you get like the heart, showing the deoxygenated and the oxygenated blood. They can relate to it because they have one in red and one in blue. So, we use it when we want to relate them to the diagrams.

Another teacher's (John) comments describing his use of the science textbook echoed the sentiments of most of the other interviewed teachers but also offered some interesting perspective on the use of the laboratory experiments and demonstrations suggested in the textbook. When he was asked if he had all the resources to perform the experiments recommended in the textbook, John replied:

Teachers are just the greatest people. I tell you, teachers are just the greatest. Our job is to guide the students and improvise when it is necessary. So, for whatever reason we are unable to carry out a particular experiment from the textbook, we help the students to visualise. The textbook in my opinion is a virtual lab. Sometimes I will say to my students, I want you to read the following experiment, then I want you to imagine in your mind that you are gathering your three beakers or you are gathering your six test tubes and test tube racks. Then, imagine that you are pouring the acid on the base. They can visualise and understand without actually doing the experiment.

In general, there are two conclusions that can be drawn from these observations. First, it is clear from the teachers' responses that science textbooks not only influence science curricula but science teachers' teaching strategies. In other words, science textbook influence not only what is taught but also how it is taught. Moreover, it would appear that the influence is intricately related to the features of the textbooks. Thus, their role in science learning and teaching discursive practices should be recognised and textbook authors and curriculum developers should provide curriculum materials to support teachers' decision making about the content and method of instruction.

Secondly, the teachers' qualitative comments once again underscore the importance of science textbooks, in general, and the use of visual representations, more specifically, in students' acquisition of scientific knowledge. All but one of the interviewed teachers reported that they use the visual representations to mediate students' understanding of scientific concepts. These data further support the findings from the teacher and student questionnaires which highlighted visual representations in textbooks as an important tool in the learning and teaching of science. Perhaps one justification for their inclusion in science

classrooms is that most students are able to interpret illustrations regardless of their linguistic background. In other words, the students' ability to create conceptual visual representation is relatively independent of their written and spoken language, and is therefore invaluable to science pedagogy in the Jamaican context.



## CHAPTER 8

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### DISCUSSION AND CONCLUSIONS

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#### 8.1 Introduction

This investigation began with central questions that are related to the extent to which secondary school science instructions in Jamaica are accessible to their intended audience. As emphasised throughout the thesis, despite the corpus of international research on the problems of instructions, including the language and readability of science textbooks, this has been a relatively unexplored area in the Jamaican setting. The shortage of suitably qualified personnel in science-related fields and students' poor performance in the CSEC science examination documented in Section 1.1 and the absence of sophisticated local research seeking to explain these concerns prompted my interest in this research.

Having presented and analysed the research findings in Chapters 4, 5, 6 and 7, this Chapter draws this thesis to a close by reflectively assembling, summarising and interpreting the main findings. This interpretation is based on the premise discussed earlier on in the thesis, and are explained and justified by wider historical forces which are social, economic and cultural. Having lived and worked in Jamaica for over 30 years, the interpretations also reflects my own experiences. I have inhabited many of those science classrooms described by the participants, both as a student and a science teacher. The contexts and communications strategies described for interpretation are situations known and experienced by me.

I begin with a critique of the conceptual and methodological frameworks employed for the thesis. I then go on to highlight the main research outcomes, indicating how the research question was addressed. The final Chapter of the thesis also attends to the limitations, strengths and contribution of this enquiry. A discussion of the implications of the findings and the direction for future research, policy and practice conclude this Chapter.

#### 8.2 Critique of the conceptual and methodological framework

As was set out in Chapter 1, the exploration was guided by one main research question: To what extent are secondary school science instructions in Jamaica accessible to their intended audience? The methodological strategy employed to address this question was discussed in Chapter 3, where I referred to the theoretical and methodological choices and explained the

philosophy and rationale underpinning it. However, it is instructive to make a few further considerations with respect to the research paradigm, and the approach in particular. It was clear to me from the outset that the question of the extent to which school science instructions are accessible to Jamaican students by its very nature is influenced by many interacting factors, hence, no single method was likely to afford a comprehensive account of the phenomenon under investigation. The study would require an approach that was capable of developing a more rounded, nuanced and multiple perspectives. Such an approach should incorporate the use of numerical and textual analysis methods and facilitates validation of the data through cross verification from different data source to maximise the credibility of the findings.

For these reasons, a multi-perspectival and multi-method approach was employed. This approach seems appropriate since not only did it address the research questions by developing multiple perspectives but it allowed for sufficient triangulation between different data sources. Indeed, researchers such as Taskakkori and Teddlie (2003) have pointed to triangulation as a core justificatory principle underpinning multi-perspectival approaches. The assumption being that viewing the phenomenon from different perspective may strengthen the validity of the results if they lead to similar findings. It may of course be the case that these multiple perspectives may generate discrepant accounts, but such possibilities can be interrogated and further interpretive activity undertaken (Creswell, 2014).

In this study, data triangulation involved the comparison of qualitative data from the interviews of students and teachers with quantitative data from the students' and teachers' questionnaires. Triangulation was also obtained by comparing the Cloze test and the readability graph data. Using this multi-pronged approach did not provide a single, clear-cut picture but rather resulted in a more complete, holistic and contextual portrayal of the issues that surround the accessibility of science instructions to the target groups. Furthermore, it may be argued that the systematic integration of the quantitative and qualitative methods complement each other's strengths and weaknesses and increase the credibility of the findings when the information from different data sources converged.

With respect to the data collection and analysis, ensuring the gathering of quality data and the accuracy of what was reported were important elements of this research. This process was discussed in methodology and methods section (Chapter 3); however, a few issues are

worth raising here in relation to the validation of the data. The issue of validation has been, to say the least, contentious in educational research, especially in relation to qualitative research (Ridendenour & Newman, 2008), with some researchers even suggesting that validation should not be among the criteria used for evaluating qualitative research. Indeed, so polemical has this area of research been that some researchers (see, for example, Guba & Lincoln, 2005) refuse to use words like 'reliability' and 'validity' in relation to qualitative research, preferring to focus on the consistency and dependability of the data. My view is consistent with researchers who suggest that no matter what the research paradigm is, some validation is essential to develop scientific rigour in the application of methods and interpretation of the data (Lee & Hubona, 2009). Thus, ensuring validation was an important consideration for this research.

Although there seem to be limited guidance in the research literature with respect to the validation of multi-methods research, there is broad agreement that "combining qualitative and quantitative approaches raises additional potential validity issues" (Cresswell & Clark, 2007, p. 145), in so far as one is able to overcome the inherent tensions in the research process of conducting mixed methods research because of the quantitative and qualitative strands requires different approaches.

The approach adopted with respect to validation in this study was consistent with the model proposed by Tasakkori and Teddlie (2003). They contend that validation emphasise inference quality which should be assessed from two perspectives: design quality and interpretive rigour. With respect to design quality, it was important that the methods of the study were appropriate for answering the research question. Consideration was also carefully given to the choice of data analysis techniques to ensure that they were sufficient and appropriate for providing plausible answers to the research question. Interpretive rigour was established by ensuring that the qualitative data were credible from the perspective of the participants. I also made sure that I accurately reported their views. In addition, the explanation developed 'faithfully' followed the findings and inferences were consistent with those of the participants and were therefore plausible. The qualitative and quantitative elements were carefully integrated in a theoretically consistent narrative, including the conclusions and applications.

### *8.2.1 The conceptual framework*

The conceptual framework discussed in this thesis draws heavily on the work of Halliday's (1978) description of systemic functional linguistics. The theory focuses attention on the dialectic relationship between language use and social context, "not only on forms of socialisation and cultural transmission, but also on role relationships, on the power structure and patterns of social control, on symbolic systems of values, of public knowledge and the like" (Halliday, 1973, p. 63). Indeed, such is the importance of context to language-production that Halliday classified it into two types: 'context of situation' and 'context of culture'. Context of situation and context of culture describe the role that sociocultural context play in language acquisition. This view of language may explain those problems faced in classrooms that are related to the relationship between the students' home language and the theoretical language use to interpret phenomena, an important consideration of this study. Thus, an understanding of the extent to which science instructions in Jamaica are accessible to their intended audience must be broadly investigated in terms of complex social formation of the Jamaican society and how culturally based norms and discursive practices are maintained and transformed in science classrooms.

Moreover, viewing language as a social semiotic establishes a continuity between science instructions and the socio-semiotic environment in Jamaica, not only in the sense that it takes into account a variety of languages, corresponding to a variety of situations, with situations interpreted by means of a conceptual framework using 'field', 'tenor' and 'mode', but it also relates language to the processes of socialisation. Language is seen as intricately interwoven with social factors, such as socio-economic background, hegemony and ideology.

Furthermore, in examining the accessibility of science instructions to Jamaican students, this study moves beyond linguistic considerations to other modes of communication. From this perspective, the work of Kress and van Leeuwen (2006) provided an important framework for conceptualising the complex array of semiotic resources which are used to create meaning. Their model draws upon Halliday's systemic functional linguistic model and, in this regard, the theoretical anchoring of language in the social is shared by all three scholars. In other words, there is broad agreement that language cannot be separated from its social and cultural context. However, Kress and van Leeuwen extend Halliday's framework beyond its origin in linguistics by providing new 'grammars' for other semiotics modes. Like language, these

grammars are seen as operating in specific and cultural circumstances. While Halliday uses the three metafunctions (ideational, interpersonal and textual) for application to the grammar of language, Kress and van Leeuwen (2006) hold the view that visual images and other semiotic systems are like language and hence are also shaped by the semiotic metafunctions originally identified by Halliday. Furthermore, they argue that language and images often act different epistemological roles in multimodal discourse, due to their separate affordances (Kress & van Leeuwen, 2006).

### **8.3 Main research outcomes**

#### *8.3.1 Language and communication*

One way of determining the extent to which science instructions are accessible to the target group was to examine the language accessibility of their school science textbook. This aspect was an important one to study since as was discussed in Chapter 1, textbooks serve as primary teaching instruments and are the dominant source of science instructions in the Jamaican classroom (Lodge, 2002; Soyibo, 1995). As outlined in Section 1.4, there is a high dependency by both teachers and students in Jamaica on science textbooks for the dissemination of information and this influence how knowledge is communicated. The readability level of the science textbook was determined by using Fry's (1968) readability formula (see Section 4.1) and a Cloze test procedure (see Section 4.3). The value of the readability formula and the Cloze test as research tools along with their limitations were discussed in Chapter 3 (the research agenda in Section 3.5). The full data for Fry's readability graph and the Cloze test are presented as Tables 4.1 and 4.2 respectively. The Cloze test performance data were triangulated with the data from the readability graph, questionnaires and interviews. This gave an insight into the extent to which the textbook was comprehensible to its intended audience, one of the issues addressed in the research question.

The empirical evidence from the Cloze test and readability index indicate, in general, that the textbook studied was difficult for the target audience to read and understand. Taken from this perspective, the research supports the conclusions of much previous research undertaken by many local and international researchers that the language demands of science textbooks continue to challenge their readers (Aldahmash et al, 2016; Khine, 2013; McDonald, 2015). The analysis of the data found that the major areas of language difficulties were related to the heavy use of scientific terminologies, the overuse of complex sentences

and the occurrence of polysyllabic words. These difficulties are especially worrying since the textbook is frequently used by teachers to assign homework to their students. It seems highly unlikely that most of these students can adequately read the textbook without direct support from their teacher.

One other problematic aspect of the textbook's accessibility relates to the large extent of new vocabulary presented in each unit. Groves (1995) and Yager (1983) pointed to this as a major obstacle to reading comprehension by a targeted audience. Indeed, Yager (1983) went even further to suggest that it was a major 'crisis' in science education. Understanding novel scientific words and concepts is extremely important to science learning. However, there is a danger that vocabulary that is introduced too quickly and without adequate explanation may create barriers for science learners. Thus, such vocabulary should be introduced sensitively and systematically.

The above conclusions are also supported by evidences from both the questionnaires and interviews data. There was broad agreement that the language used in science textbooks and science discourse posed significant challenges for the students. Consistent with the data from the Cloze test and readability graph the main challenges identified were with respect to the specialised lexicon, semantics and syntax of the science register. While many students and teachers saw the language of science as a necessary tool to support reasoning and expressing ideas about the natural world, they expressed reservations about the impersonal and inhuman nature of the scientific language used in their science textbooks. These language concerns are shared by many science researchers, such as Flower (1980) who polemically described the language of science as having 'minimum intelligibility'.

The student questionnaire respondents and the interviewed students were particularly bothered by what they considered to be the unsystematic presentation of technical words. Undoubtedly, as Halliday (2004) points out, technical terms are an essential part of scientific language, since it would be impossible to create a discourse of organised knowledge without them. But, it could be argued that the textbook has placed considerable emphasis upon technical terms as a primary ingredient of science. It is precisely this portrayal that Lemke (1990) believes has led to a particular ideological positioning of science, ideological in the sense that there is a strict adherence to patterned language use with little consideration for

the social dimensions of language use. Such an impoverished perspective has resulted in a narrowly framed view of language in science instructions.

The above narrative of language instructions in the science classroom poses troubling problems for educators, since some scholars have argued that it is the kind of language through which science is construed that has alienated many students from science (Lemke, 1990). This may explain, at least in part, why so many of the questionnaire respondents and interviewees held such negative views about science. Indeed, considering the Jamaican linguistic situation discussed throughout this study, it seems reasonable to argue that the language of science poses even more problems for the students in the junior high, technical high and upgraded high schools where the majority of the students are Creole-speaking and have very little proficiency in JSE. These students have to translate, integrate and reinterpret meanings across two languages, as well as connecting these modes to earlier experiences of science instructions.

The questionnaire and interview data clearly highlight the importance of science textbooks in Jamaican classrooms. For many teachers, they are central to the teaching of science and this has led to what I believe is an unhealthy overreliance on them. This overreliance was more apparent in the junior high, technical high and upgraded high schools. When compared with the private high and traditional high schools, these schools have far fewer resources and this might explain why these teachers rely so heavily on the textbook to provide them with curriculum materials. This has been highlighted in Soyibo's (1996) examination of the communication strategies of three Caribbean high-school biology textbooks.

There is also another explanation that it is worthwhile to consider. It was clear that in junior high, technical high and upgraded high schools most of the science teachers were teaching outside their own area of expertise. Indeed, some of the teachers who took part in the survey were recent graduates of the school, with no formal teacher training. Such strategies are typically employed by head teachers to address teacher shortages. In such a situation, it could be argued that the teachers' overreliance on the textbook may be a way of masking their own lack of understanding of scientific concepts.

There was also evidence to suggest that the heavy reliance on science textbooks increased the use of the 'chalk and talk' methods in classroom discourse (my use of 'discourse' here refers to the use of language in a social context). Such practice clearly has an influence on the

view of science that is made available to the students. In these classrooms, science is typically presented as a transmission of facts, with little or no attention paid to the social dimensions of scientific knowledge. Chiappetta et al (1991) warn that this may give students a false impression of the nature of science and may reinforce a mythological account of science.

What is even more worrying is that the use of teacher-centred approaches such as the 'chalk and talk' method limits the opportunities for the students to 'talk science'. Talking science is restrained through the implementation of strict use of language specific to the thematic content as interpreted by the teacher. Such practices ignore a social constructivist perspective on science learning, which brings together the social interactive and personal sense making parts of learning in developing conceptual understanding. As Lemke (1990) puts it, "it means learning to communicate in the language of science and acting as a member of the community of people who do so" (p. 1). Lemke's quotation points to the dialogic nature of the science classroom, "involving, persons-in-conversations" (Driver et al, 1994, p. 7).

Although the textbook studied was intended for use with all students, it was found that most of the students in the junior high, technical high and upgraded high schools liked it less than did other students, mainly because of its language demand. These observations might suggest that it will be extremely difficult, perhaps impossible, to produce a textbook which is suitable for students of all abilities. Rather than having a one-size-fits-all approach, textbooks should become more flexible in content, process and product based on students' strengths, needs and learning styles.

Evidence from both the questionnaires and the interviews suggest a correlation between the ways in which science teachers use their textbooks and the teaching strategies they employed. In all the five schools investigated in the study, it would seem that most teachers used the textbook as a source of reinforcement to supplement science discourse and teachers' subject narrative.

### *8.3.2 Language accessibility and social class*

An important finding of the Cloze test was that most of the students in the junior high, technical high and upgraded high schools were reading at frustration level. This was in stark contrast to their counterparts in the private and traditional high schools where many of these students were reading at the independent level. Undoubtedly, the underlying reasons for



these results are varied and complex. However, if one accepts the argument put forward earlier that students from the poorest background are the group most likely to enrol in the junior high, technical high and upgraded high schools, then it seems reasonable to make a connection between the students' socio-economic status and their ability to access the school science textbook.

The conclusions drawn above were also supported by data from the questionnaires and interviews. Many of the participants who reported difficulties in accessing science instructions were from the junior high, technical high and upgraded high school. Similarly, teachers in these schools reported that most of the students were slow in reading and learning new scientific concepts and had major difficulties with the themes and topics in the textbook, which they regarded as dull and uninteresting. Conversely, the participants attending the private and traditional high school found no major difficulties in accessing science instructions. Indeed, their foremost concern was that they found the textbook inadequate in terms of the content coverage.

Such inferences are reinforced regularly in literature which focuses on Jamaica and the education system. For example, Reid (2011) found that students of a low socio-economic status consistently experience barriers, both self-imposed and external, which influence their reading. At the same time, Samms-Vaughan (2004) found that children of families with higher socio-economic status had a more positive attitude towards reading than those of their counterparts from families with lower socio-economic status. Samms-Vaughan highlighted parental support as a major factor to explain these differences. Poorer parents may have less time to spend with their children because of work demands. These children receive low levels of encouragement from parents to read. Conversely, wealthier parents are more likely to read to their child and provide financial, human and social capital to give their child a richer learning environment to foster better attitudes towards reading. Samms-Vaughan's (2004) research is consistent with similar studies undertaken in the UK which show that parental involvement in their children's learning positively affects their child's reading outcomes.

It is also the case in Jamaica that parents of children of families of low socio-economic status have great difficulty providing educational resources such as school textbooks. Unlike state schools in the UK, government-run schools in Jamaica require students to pay a 'donation' as a contribution for the year, referred to as maintenances fees. In most schools, these fees are

mandatory and, if unpaid, parents at times are not able to receive their child's end-of-term reports. Indeed, White (2015) has cited numerous instances of students being sent home from school because of non-payment of this fee. At an average of US \$500 (White, 2015), these fees present huge financial burdens for low-income families. This situation is exacerbated by the high incidence of households headed by single females.

### *8.3.3 The language of science instructions*

Data from both the questionnaires and the interviews indicated that most teachers and students acknowledged the bilingual environment and JC as primarily their first language, the language they were most comfortable with. Broadly speaking, participants in all the five schools investigated in the study have some pragmatic understanding of the significance of success in JSE, with those in the private high and traditional high being more willing to voice their concerns about its role in classroom instructions. For these participants, JSE was the key to personal growth and the crucible of literature and culture. They consistently emphasised the importance of delivering the science curriculum in JSE. In contrast, the participants in the junior high, technical high and upgraded high schools were more ambivalent about JSE, seeing it as having no expressive value while at the same time recognising its international importance. In this sense, JSE is viewed as a tangible commodity that they can manipulate and use for their own purposes.

The participants' attitudes to JC showed ambivalence, but it was acknowledged as a significant marker of cultural identity. The validation of JC by some participants in the sample is a positive shift from earlier studies that had reported more conservative attitudes towards Creole among teachers in Jamaica. This change is encouraged in a context in which children in the junior high, technical high and upgraded high schools may still be bilingual in JSE and JC, but who may also be dominant speakers of JC. A determination of language distribution patterns in the wider Jamaican community would require a much larger sample comprising more participants from different geographical regions.

The teacher interviews also suggested that they were well placed to understand the linguistic struggles some children experience within the school system. Translanguaging was encouraged as a natural part of scientific discourse. Cummins (1994) saw this as creating "conditions for interaction which expand students' possibilities for identity formation and critical inquiry" (p. 47). These observations are part of the growing recognition by the teachers

that their classroom is a bilingual and bicultural environment and, thus, by linking modes of discourse between home, school and community, “students’ voices can be expressed, shared and amplified within the interactional process” (Cummins, 1994, p. 47).

#### *8.3.4 Visual representation*

With respect to the visual representation, the results from the study are consistent with what has been found in many international studies undertaken on the sociocultural dimensions of school textbooks. For example, there was evidence that although some change has occurred in the direction of ‘gender fairness’, the textbook showed an implicit support of gender-biased messages. There were slightly more males than females in the textbook images. In addition, as in the findings of many of the studies discussed throughout the study (see, for example, Bazler & Simonis, 1991; Elgar, 2004; Potter & Rosser, 1992) males and females were portrayed in stereotypical ways that reflect and sustain socially endorsed views of gender. Typically, males were portrayed as competent, powerful and in high-status ‘positions’. Such representation, I would argue, reinforces long-standing cultural ideals of masculinity.

What is also interesting to note is the ways that males were not portrayed in the textbook. There were no males presented doing housework or taking care of children. Indeed, in all cases where someone was shown in a domestic role, that person was always a female. This perpetuates a negative stereotype of men as uninterested and uninvolved in home and family life.

Images of females in the main reflect cultural stereotypes that were consistent with the social realities that currently exist in Jamaica. They were frequently depicted in roles that epitomise ‘traditional’ women’s roles-cooking, cleaning and child care. These stereotypical representations of females reinforce several harmful beliefs. First, they may suggest that females are, first and foremost, helpmates and supporters of men and families, thus reinforcing the traditional dominant-subordinate pattern of male-female relationships. Secondly, they may imply that women inherently have different interests and are better at some things compared to men (gender essentialism), for example, that women are better at domestic tasks than are men.

These issues are important, as the existence of gender-related inequalities, especially gender stereotyping in science, places restrictions on individuals and may deter them from pursuing

scientific careers in Jamaica. Such misrepresentation of gender may also distort how students see themselves and what they perceive as normal and desirable for males and females.

Although this persistent pattern of disparity of representation is worrying, it is by no means surprising, given the lack of representation of female scientists in the textbooks of other countries. For example, Blickenstaff (2005) in his discussion of scientists in the USA speaks of women scientists bordering, for a variety of reasons, on the 'invisible'. He argued that a low representation of women in science textbooks may send a message to girls that science and related fields are unattractive to women and they should avoid them. Along the same lines, Hanson (2008) lamented the lack of female African American scientists in textbooks. She maintained that if female students are not presented with successful women scientists as role models, this may reveal a subtle message that women and girls occupy a less important role in the science community than do men or boys. Indeed, the lack of female African American role models in science was connected to lack of success in science by one female participant in Hanson's (2008) study, when she commented that "we don't have role models of women in science. You're more geared to learn and participate more if you have someone you can look up to. I do not recall any study of female scientists when I was in high school. I only remember studying male scientists and inventors. Even though there are plenty of [women] working or studying science I believe that men are mostly recognised" (p. 61).

Connell's (1987) account of hegemonic masculinity and how this practice is employed to construct and legitimise men's dominant position in society while justifying the subordination of women offers a means of making sense of the 'politics of representation' at issue here. Applying Gramsci's (1971) concept of 'hegemony' to gender relations, Connell (2005) understood hegemonic masculinity as "the configuration of gender practice which embodies the currently accepted answer to the problem of the legitimacy of patriarchy, which guarantees the dominant position of men and the subordination of women" (p. 34). The concept takes as its foundation that the relationship of men to woman is oppressive and thus by casting women in the role of home makers in the narrative and visual imagery of science textbooks reinforces a value system that discriminates against females while at the same time presenting males as independent and in control (Kimmel, 1994; Lamont, 2015; Messner, 2005; Norman, 2011). Such a regime of representation depicts a 'hidden curriculum' of what

is considered a natural form of social organisation, and this may influence children's academic and career interests (Bazler & Simonis, 1991; Elgar, 2004; Potter & Rosser, 1992).

There is also another point that it is worthwhile to mention. The regime of representation at play here may also be explained in terms of what Hall (1997) described as 'the spectacle of the "Othering"'. Indeed, I would argue that the idea of "othering" is a central concept in critiquing women's and girls' subordination in visual representation in Jamaican school science textbooks and in analysing the intersections between gender differences and other dimensions of subordination such as sexuality, class, and disability. And yet, curiously, it is one that is not explicitly discussed in cultural representational discourses (notable exceptions include Mehta, 2009; Mohammed, 2009; Rowley, 2010).

Undoubtedly, gender issues in Jamaica are extremely complex, and often exhibit a texture that is somewhat different from those identified by gender scholars in other countries. However, the male gender has been privileged historically in Jamaican society. Indeed, males have had access to a broader social space, have had greater control over a wider range of resources and have been more able to enjoy the resources that they have controlled; have maintained a more prestigious position in society; and have exercised greater power in practice, regardless of the respective power potentialities of genders in history (Figueroa, 2004).

Masculinity is therefore socially constructed as the universal norm by which social ideas about humanity are defined, discussed and legislated against (Connell, 2000). Thus, as Simone de Beauvoir (1949) argues in the introduction to her ground-breaking work *The Second Sex*, humanity is male and man defines woman not in herself but as relative to him: "She is defined and differentiated with reference to man and not he with reference to her; she is the incidental, the inessential as opposed to the essential. He is the Subject, he is the Absolute – she is the Other" (p. xxii). This distinction – between man as Subject and woman as Other – operates in the logic of hegemony and is normalised through a cultural logic of reproduction.

As a social norm, the notion of "othering" is embedded in relations of power. Although there are entrenched, pervasive, and ostensibly intractable variances over the nature of power relations within a social structure (see, for example, the Stanford Encyclopaedia of Philosophy (2016) discussion of the conceptualisation of power as a resource to be redistributed, as domination and as empowerment), there is tacit agreement amongst scholars that gender

and power relations in the Caribbean context should be understood in terms of dyadic relations of domination/subordination (Bailey, 2002). Writing about the conception of power as domination, MacKinnon (1987) argues that gender difference is itself a function of domination and, as she puts it, “the social relation between the sexes is organised so that men may dominate and women must submit” (p. 3). The implication here is that men are powerful and women powerless. As MacKinnon articulates, “women/men is a distinction not just of difference, but of power and powerlessness” (p. 123).

Some radical feminist scholars have even used the master/slave analogy to describe the power relation between men and women. For example, Pateman (1988) argues that gender difference is constituted by domination (Pateman uses the term ‘domination’ to refer to an unjust or oppressive power-over relations); as she argues that “in modern civil society all men are deemed good enough to be women’s masters” (p. 219). Pateman calls for a model to understand this male/female master/subject dyad. The salient feature of this conception of power is that it is understood as what Foucault (1983) described as a ‘power-over relation’. Under such conditions of subordination, power is usually directed against women, who do not have the power to define the terms of their situation. Although this claim is itself contested, there is no doubt that the common thread that emanates in the literature of most feminist scholars seems to have sided with view. Such a view may be summarised in Dahl’s (1957) one-dimensional conceptualisation of power, according to which “A has power over B to the extent that he can get B to do something that B would not otherwise do” (p. 202). Luke (1974) added that “A affects B in a manner contrary to B’s interests” (p. 30), namely, one that is unjust or illegitimate. Taken from this perspective, othering may be understood as a “process of differentiation and demarcation, by which the line is drawn between ‘us’ and ‘them’ – between the more and the less powerful – and through which social distance is established and maintained” (Lister, 2004, p. 101). Hall (1997) argues that such differences – ‘them’ rather “us” – are frequently exposed to extremes binary forms of representation.

With respect to race, the school science textbook studied seem not coherent with educational policies that favour the construction of racial diversity and shared identities. Albeit, the findings appear to show some growth towards a more balanced representation of racial groups. The stereotyped image of white male scientists which dominated Jamaican science textbooks in the 1970s and ‘80s (Whiteley, 1996) seems to have disappeared and

considerable effort has been made to portray scientists and other personnel in science-related fields in a more diverse way. Even here, though, some racial groups were completely absent from all depictions. Furthermore, the over-representation of African-Jamaicans in the images was an interesting finding that some might see as an instance of 'reverse racism'.

One consideration for this type of research is concern as to who should be represented in science textbooks. My own view is that textbooks should increase the representation of groups that have been historically underrepresented or misrepresented, not only in science but in society more generally. In Section 1.6, I described Rastafari as one such group. As I made clear in my discussion, Rastafari are typically thought of in Jamaica as fanatical cannabis-smoking revolutionaries who frequently engage in unlawful actions. Such distorted understandings and attitudes have contributed to the marginalisation and social exclusion of Rastafari in every aspect of the society, including education (Dunkley, 2013).

As mentioned in Section 5.1, there were no visual representation of Rastafari in the textbook. This is of some concern since their absence may reinforce negative attitudes directed towards the Rastafari community. Moreover, although it is not clear how a student's perception of how they are visually represented in textbooks impacts his/her learning, attitude towards science, achievement and/or participation in science, it is reasonable to argue that lack of visual representation may impact negatively on Rastafari perceptions of self and of their communities.

#### **8.4 Recommendations**

In correcting the pervasive inequities in science instructions highlighted by the participants in this study, it is useful to reflect in a general way on the UNESCO (2000), Dakar framework for action (Education for all). It suggests a comprehensive approach to the restructuring of the education system that ensures an education of quality for all students regardless of gender, socioeconomic status or race. The framework acknowledges discrimination as one of the most problematic shortcomings in realising the right to education, and in this respect advocates that efforts in equality must include explicit actions to address discrimination resulting social attitudes and practices, racial prejudices, stereotypes and economic status. Thus, the following recommendation points to the direction of actions that will need to be taken, to facilitate such an environment and to ensure that science instructions are accessible for all Jamaican students.

#### *8.4.1 Linguistics issues*

Throughout the thesis, I have argued that JSE has had a hegemonic effect on science instructions in the classroom. This argument has been supported by data from the student and teacher interviews. Indeed, throughout the interviews the dominant view of the students was that their home language was not valued within the formal education context and, consequently, teachers did not promote or encourage them to express their ideas in JC. Similarly, many teachers argued that the use of JC within the classroom environment would lead to the degradation of JSE. Such arguments are tainted by neo-colonial biases inherent in the work of many hegemonic JSE narratives. This narrative, in some of its central aspects, is both social and political, focusing on the attitudes of many to the use of JC in science instructions.

Perhaps a stronger argument against JC use in the science classroom is one which concerns fundamental scientific terms that do not have any Creole equivalent. In such cases, a term might need either to be borrowed from JSE or invented – which I would argue is precisely how language evolves. Indeed, English speakers have often created scientific terms by inventing neologisms with Latin and Greek roots. Advocates of borrowing further argue that even Latin and Greek also borrowed from other languages (Lancor, 2014). Therefore, JC, like any other language, has the means to expand its science vocabulary as needed.

In other cases, it might be that while there isn't a single word in JC for a certain term (e.g. gravity), the scientific concept can adequately be described in JC using a circumlocution. For example, in many languages 'gravity' is represented by 'the force that causes objects to fall to Earth'. By 'can adequately be described' I do not mean that the scientific term 'gravity' is identical to the phrase 'the force that causes objects to fall to Earth' but for school teaching purposes the phrase is enough to get going and a clarification of what is meant could continue (e.g. we aren't just talking about a force to Earth) in JC without resorting to JSE.

However, if one accepts the notion that the use of talk in science instructions is fundamental for exploring phenomena, reasoning and arguing from evidence, then it is crucial that a linguistically rich, non-threatening environment is established. Within this paradigm, linguistic diversity is infused and encouraged throughout the classroom by including both JSE



and JC within science discourses and instructions. In this way, learners will feel that their home language is valued and, consequently, will feel free to express themselves in these discussions. Such a pragmatic and common-sense approach offers significant pedagogical advantages, as reported consistently in the bilingual education literature (see, for example, Garcia, 2009).

In what I have suggested above, there would be less emphasis on the writing of JSE by science students since it restricts their ability adequately to express scientific ideas and creativity. Adopting such an approach will no doubt pose challenges for science educators and policy makers. Even if the general societal consensus changed and became more favourable to Creole-based materials, a key unresolved question would still be whose variety of JC should be used, granted the existence of a Creole continuum rather than a dichotomisation of JC and JSE(see Section 2.9).

The ideas that I have put forward are not without their problems and internal tensions. However, a pedagogical approach which underlines the importance of language in science teaching, while promoting mother tongue-based education, is a valuable model to improve students' engagement in science classroom discourse.

#### *8.4.2 Teacher training*

The need for teachers to be able to handle JC-based discourse and reading behaviour in a sensitive and enlightened way highlights the importance of teacher training. Indeed, the Jamaica's Literacy Report stressed the training of teachers: the need to develop personnel who are language aware and able to see the differences in the language resources children bring to school in their many different voices. If the teachers are knowledgeable about JC as a language system in its own right, negative attitudes and behaviours among teachers are likely to be less frequent. In addition, they would be likely to be more tolerant of JC 'errors' and be able to discriminate between miscues which merely reflect the only language resource available to the students and those which require instructional attention because they violate syntactic and/or semantic acceptability. Teacher rejection of JC can lead to Creole-speaking children being unable to express themselves adequately in science, and in other subjects.

It should be understood that I am not advocating a laissez faire attitude to accuracy when reading. But it would be strange if the language in which the child is psychologically and linguistically most comfortable was not evidenced in his/her reading and writing performance. Thus, unless the teacher is willing to accept some intrusion of JC, the child may be unable to function to its full potential.

#### *8.4.3 Affective factors*

It is a curriculum commonplace to emphasise that the teaching and learning situation represents a complex interplay of sociological, psychological and pedagogical factors. Thus, increasing attention has focussed on teacher variables and affective factors as possible contributors to the problems that Creole-speaking students often face when using JSE science materials. For it must be the case that JSE may have no psychological utility for the Creole speaker, granted the nature of her/his interaction with significant others in her/his language/social community. In such a situation, motivation to read science content, especially in JSE, could be a major problem. For if one accepts that reading (science) does not have the same survival value as oral communication, it would follow that a necessary prerequisite for reading science content is sufficient motivation. Such motivation is hardly likely if the science material does not relate to the reader's deeply felt subcultural and psychological experiences. In a Creole context, therefore, motivation in science curriculum terms must mean more than instructional technology of well-chosen visual aids and so on. It must mean materials which reflect in a very personal and fundamental way the socio-cultural milieu of the pupils. The whole ethos of the material must be such as to facilitate identity.

### **8.5 Limitations**

Although the present study has yielded important findings with respect to the research question, it is not without limitations. A number of caveats need to be acknowledged. First, the study only examined one science textbook used for science instructions by Jamaican year 7 students. Although this textbook was described in Chapter 3 as the most extensively used by the target students, it should be noted that there are other science textbooks recommended by the Ministry of Education. While past studies seem to suggest that science textbooks in Jamaica are very similar (Soyibo, 1996), nevertheless there may be some differences in how language is treated in these textbooks. Additionally, it is still the case that

Jamaican science educators have not yet reach a consensus about the teaching and learning of particular scientific ideas; thus, there may also be variation in how topics are ordered and developed (this is an important point since data from the study indicate that textbooks are used as the de facto curriculum for science instructions (Section 6.4)). With a larger corpus of Jamaican science textbooks it might be possible to draw more meaningful data than the ones collected in this study and enhance the generalisability of the findings.

The questionnaires and interviews data provided a context for various inferences concerning the extent to which science instructions were accessible to the target audiences and for the development of these arguments. However, there were also several limitations with respect to the questionnaire and interview data. First, data on the students' and teachers' judgments about science instructions in the classroom were obtained using self-administered questionnaires and semi-structured interviews, as reported in Chapter 3. Research focussed on such methods has demonstrated that a number of factors, such as transient mood states, social context surrounding the respondent and other contextual factors can significantly influence responses to questions related to judgement and attitudes (see, for example, Jupp, 2006). These momentary factors may have influenced how some participants responded to questions about science instructions in the classroom. For example, a student might report negatively about science instructions in their classrooms if he or she had a confrontation with their teacher prior to completing the questionnaires or attend the interviews. Similarly, some respondents may skew their responses to what they see as controversial issues based on their projections of the norms of those with whom they are interacting.

Secondly, by their very nature self-report questionnaires rely on the honesty of the participants. Although it is difficult to quantify the degree to which this was a problem in this research, it is possible that some participants were less honest about some of the issues raised on the questionnaires, and indeed the interviews. For example, as Alleyne (2005) points out, people are prone to over-report the possession of high-status attributes and under-report having low-status attributes. In the Jamaican context, as reported throughout this research, speaking JSE was equated with high social status and wealth and speaking JC with lower social status and poverty (Alleyne, 2005). Thus, it is possible that some participants might have been less than be honest about declaring themselves speakers of JC.

Thirdly, the questionnaire data may have some elements of response bias. With questionnaires such as the ones used in this research, the respondents are more likely to respond if they have a critical comment to make. Moreover, Hoskin (2012) has shown regarding data on yes/no questionnaires that respondents are more biased to responding yes, even if they have had a minimal evidence to decide yes. Thus, it might be the case that some participants might have been biased in answering such questions as ‘Do you like your science textbook?’.

As outlined in Section 1.4, I have used the concept of race to refer to a person’s physical appearance, such as skin colour and hair texture. Some may argue that my use of race within this framework is based on a perceived difference in genetic make-up, a description that has been overwhelmingly rejected by the large majority of experts in the science community (see, for example, Yudell et al, 2016). Indeed, it is widely accepted that race is a construct of both social and cultural differences among different groups of people, without biological meanings. Racial categories used to differentiate human differences have been created and change to meet the dynamic, social, political and economic needs of society. Hence, the idea of African-Jamaicans, European-Jamaicans, Indian-Jamaicans and so on, as discrete groups, ignores the scope of human diversity.

Furthermore, in the literature on race it is often assumed that labels such as white, black, Chinese and Indian are universally applicable across communities. However, in Jamaica a ‘brown-skinned’ individual maybe considered to be ‘white’ in some quarters and ‘black’ in others. The cultural context is important in determining what identifies groups of people as members of the same racial group.

## **8.6 Further research into the accessibility of science instructions**

This investigation has fundamentally been about a better understanding of Jamaican science classrooms, about the social and cultural factors which affect equity and access to instructions and the extent to which these factors enhance or act as barriers to science instructions. In many respects, the description of such classrooms has just begun and, consequently, the thesis has touched a number of areas that need further study, to extend our understanding of the complexities of science instructions in the Jamaican context. First, I am suggesting a longitudinal design study of the complex relationships among the various institutional, social and political factors that influence students’ accessibility of science instructions, combined

with greater attention to the potential contributions of the many epistemological, ideological and social dimensions of language use. Just as teachers must learn to cross social and cultural boundaries in order to make school science instructions meaningful and relevant for all students, researchers must learn to cross the boundaries of multiple theoretical perspectives separating different theoretical terrains and methodological perspectives if they are to unravel the complex connections between social and cultural factors and science instruction. Such a study should produce a significant and powerful addition to what has been discussed in this research.

Secondly, future research should also consider in greater depth the cultural and linguistic experiences that students from different background bring to their science classrooms and the ways in which teachers selectively and systematically construct science discourse so that students can articulate their experiences with science disciplines. In addition, further research needs to identify those areas of science instructions where JC can serve as an intellectual resource, so that Creole-speaking children can construct meanings based on their linguistic and cultural experiences.

Thirdly, future research should include intervention studies in which the effects of using JC in the classroom are studied. Conservative critics will no doubt strongly oppose such a proposal. However, the educational benefits of such research have been recognised within the Caribbean and beyond. For example, in 1979 an intervention study into using Creole as the language of instructions was ordered by the Ministry of Education in Haiti. The study reported that the use of Creole in classrooms allowed teachers and students to interact naturally and negotiate meanings together. Moreover, the researchers found that the use of the students' home language made the students enjoy learning more and display greater confidence and self-esteem (Devonish & Carpenter, 2007). A year later, a standard Creole writing system was adopted and formed the basis for the educational reforms that took place (Devonish, 1986). A similar situation can be traced in the Republic of the Seychelles, a former British colony in which a French lexicon Creole is the vernacular. Seychelles inherited an education system, like Jamaica, in which English was the language of education. The result was a high adult illiteracy rate and high failure rate amongst those attending school. In response to this problem, the government ordered an intervention programme to look into the intellectual benefits of Creole instructions. This study reported similar benefits to that found in Haiti.

Local educationists (as cited in Weber, 2014) argued that the change in the medium of instructions from English to Creole led to improved literacy and personal efficacy for the student and created a participatory learning environment that supported cognitive as well as linguistic development. Shortly after, Creole was implemented in the education system as the medium of instructions for subjects such as mathematics and science. The experiences from the examples cited above have important lessons for a Jamaican bilingual education model.

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## APPENDICES

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### Appendix A: Transcript of group discussion (Traditional high school)

**Participants:** Kameka, Barbara, Nyree, Tammi, Jane (pseudonyms)

**Interviewer:** OK, well I think we should probably should start because we are running a bit late. So thank you all very much for agreeing to participate in this discussion. As you know, having been kind enough to read the information sheet, I am interested in the accessibility of science textbooks to Jamaican students- looking specifically at the extent to which the language of science in textbooks acts as a barrier to students' engagement in science. The purpose of this session is really for me to get in your own words the sort of things you think about your science textbook. I have got a number questions which I would like us to discuss. Anything you say will of course be totally confidential. I will be recording and transcribing this session but it will only be used for my purposes to help jog my memory. I will ask you a question and then ask each of you perhaps to comment. You don't have to answer any questions if you don't want to however I am hoping you will. Also you can use either or both Jamaican Standard English or Jamaican Creole in your discussions.

**Interviewer:** OK, so what do you think makes a great textbook? Any one wants to talk about that [pause] What makes a great textbook?

**Barbara:** For me a great textbook is a textbook that explains, break it down completely [pause] say if a teacher teaches a certain way and you as a student can easily go back to your textbook and find and understand it differently and with the use of diagrams and tables its better understood.

**Tammi:** I think a good textbook is one in which the language is clear and easy to understand, Umm [pause]. It should be well written and have some really good pictures to explain come of the scientific ideas. A good textbook should have interesting diagrams and pictures. I think I learn a lot from diagrams and pictures. Oh [pause] and sir, it must have enough information so we can study and pass our exam.

**Kameka:** Sir [pause] a good textbook must be easy to read and understand. It is one that doesn't jump between ideas but link them in a logical way.

**Interviewer:** That's interesting [pause] do you want to say something more about what you mean?

**Kameka:** Well, I mean, [long pause] sometimes when you read your textbook it is a bit confusing because it is not written in a good sequence. So how the topics are set out is important.

**Interviewer:** Anyone else wants to add to what has been said already?

[Silence]

**Interviewer:** OK lovely. What do you think about your science textbook?

**Jane:** I think it is very complex. Reason being that some information and explanations are not quite broken down as you would want them. So most times I struggle to revise for test and do homework from it.

**Interviewer:** When you say the information and explanations are not broken down [pause] what do you mean?

**Jane:** Well, sir, science have a lot of difficult vocabulary and sometimes when you are reading these words they are difficult to make sense of [pause] so it would be easier to read if the words were broken down simpler.

**Kameka:** My textbook [pause] ummmm with the aid of my teacher after he explain it in class and I have a level of understanding to know that if I am going to use the textbook it would [laugh] would be easier to understand when you use the notes from the class with the textbook will give us a better understanding. I would have to say though that I struggle to read it without my teacher breaking it down.

**Nyree:** I love science but my science textbook provide little in the way of motivation. Reading the textbook is very boring. I can't stand reading passages and pages upon pages of boring science. It needs to make the science livelier especially because we don't do a lot of experiments.

**Barbara:** I like my science textbook but I think it can be improved.

**Interviewer:** Tell some more about that? How do you think it can be improved?

**Barbara:** Meaning it can go into more details and that you will understand more what it is saying about, what it is talking about.

**Tammi:** Like some of the topics are in the textbook that we use no really detail like what Barbara say it no really go in depth on the topic – it just give you a few jotted notes and you have to do like most of the reading from other sciences book.

**Jane:** You have to have a certain level of understanding to read it [pause] cause some of the words in dere not in our vocabulary.

**Interviewer:** When you say not in our vocabulary what do you mean?

**Jane:** Meaning that it advanced in some way but if you have an understanding [pause] if you know how fi (to) research based pon di topic you understand.

**Barbara:** Sometimes the vocabulary can make the textbook hard to read. For example, you have different names for the skull like you would say cranium and most times the textbook will use dat word instead of saying the skull. If you don't have an understanding of what it is saying you will get mix up at times.

**Nyree:** Like when Miss was giving us the skeleton to label aahm, some of us write skull like Barbara say and some of us write cranium and den Miss tell wi seh di right word wi fi write is skull.

**Interviewer:** So, your teacher say the right word is skull instead of cranium.

**Students Chorus:** No the correct word is cranium instead of skull but she wants the scientific word.

**Interviewer:** Right [pause] understand what you are saying.

**Jane:** Skull is the local name.

**Interviewer:** So, does she mark it incorrect if you write skull?

**Kameka:** If you write skull, you get it incorrect.

**Interviewer:** OK [pause] Even though it's the same thing?

**Students' chorus:** Yes sir!

**Interviewer:** So, what are the good thing then about your textbook being written in Jamaican Standard English?

**Tammi:** The good thing [pause]

**Interviewer:** Yes

**Nyree:** Can you please repeat?

**Interviewer:** Are there anything good about your textbook being written in Jamaican Standard English?

**Nyree:** Yea, the good thing is that it build up your vocabulary like fingers for instance is called phalange, it make you know big words it help to build your vocabulary.

**Kameka:** Yes, it help build up di vocabulary because when you go into the wider world most time in all [pause] not in all cases you will find persons not using the local name but the scientific name so it is better when it's in Standard English.

**Interviewer:** So what if your science textbook was written in Jamaican Creole? How would you feel about that?

**Barbara:** Well a wouldn't feel good about writing a book in Jamaican Creole cause you have to remember that Jamaica patwa is a broken language mix with English and pass ancestry and whatever but a tink if you only going to make it only Jamaican based and whatever, you know appreciating culture you can write it in dere but a tink dat would a haffi be a more a culture, a cultural setting more than a science setting because when learning science you not you not only learning to be local you learning it to be like international or [ long pause]

**Interviewer:** Uum [pause] interesting perspective. [pause] Anyone else wants to comment on that? What if your science book was written in Jamaican Creole?

**Nyree:** If our science textbooks were written in Creole it wouldn't impart much knowledge in our heads that when we go out and relating to the subject we will only can communicate with Jamaicans because not everybody understand Jamaican Creole because it's broken language and you cannot write that in a English exam.

**Interviewer:** Let's take the example you mentioned earlier with cranium and skull. Do you think, that it is right for the teacher to mark your work incorrect because you wrote skull instead of cranium [pause] even though they mean the same thing?

**Tammi:** If I think it is right that it in Jamaican Creole?

**Interviewer:** That that the teacher is correcting you because you, you have written skull instead of cranium?

**Barbara:** Yea because if, if me write skull an it wrong an the teacher, rememba seh the teacher know more, she have har degree an whatever she ago correct wi and tell wi di right ting so yeah u have to listen yeah

**Interviewer:** How often do you use your science textbooks?

**Jane:** Basically, wi can use our textbook in every class because the topics that she do, not always come from that but you can relate back to the textbook.

**Interviewer:** How often do you use it? Do you use it like once a week, twice a week?

**Nyree:** Wi use it like every class wi come, basically [pause] yes sir.

**Interviewer:** OK, what do you normally use them for, your textbooks?

**Kameka:** Well, well the teacher give us it like shi tell us to write tings out a di textbook , jot down tings out a di textbook to rememba and sometimes she leave us in di class to like read di textbook and like understand and den she ask wi what wi understand from reading di textbook.

**Nyree:** Well wi use di textbook fi like draw diagrams, get notes outa it and read and understand it.

**Barbara:** We use our textbook to give us a wider understanding and knowledge of what the teacher is talking about when she gives us a brief highlight we can read in the textbook for more information and we use it to draw diagrams and understand it.

**Interviewer:** When, when you talking to the teacher in the class, do you always use Jamaican Standard English?

**Tammi:** If we always use Standard English? [pause] aahm, not really, like sometimes wi use patwa, Miss normally talk Standard English but we use patwa and she understand and gi wi feedback.

**Interviewer:** OK, Does she encourage you to talk in patwa or does she tell you to talk in Jamaican Standard English?

**Jane:** She encourage wi fi talk in Standard English like you say a wah? She always look at you and say that's not how you supposed to say it. You supposed to say is what or something like that. She always encourage wi.

**Interviewer:** Is that all the time?

**Barbara:** Yes, sir because she get, she go college and so forth and she do English and she goodda all get degree in dere and so forth so you supposed to listen whatever your teacher is saying a think that's a good idea for she to teach us how to talk in Standard English.

**Nyree:** Well when it comes to the terms of patwa, I think we should really appreciate the dialect but when it comes to classroom settings remember you not only learning it for local but you have to appreciate the patwa at the same time.

**Interviewer:** So, do you think then that patwa has no place at all in the classroom when it comes to teaching science?

**Nyree:** Not really but sometimes if the teacher is explaining in Standard English and nobody in the class have an idea of what she is saying she will have to go break it down and talk patwa so that the students can understand.

**Interviewer:** Does that happen frequently?

**Nyree:** Not in all instances, sometimes.

**Interviewer:** Can you give me an instance where you didn't understand what the teacher was saying in Standard English and then she use Jamaican Creole?

**Barbara:** Like some, like one time, we did the food chain miss did seh di seh vulture and dem neva understand and Miss seh joncrow and den everybody understand.

**Interviewer:** Was that a good thing?

**Nyree:** Yeah 'cause is not everybody understand Standard English cause a lot of people in Jamaica same way can't talk Standard English.

**Interviewer:** Do you do you know the hibiscus plant?

**Students' Chorus:** Yes sir.

**Interviewer:** Do you know the local name for it?

**Jane:** Yea, wi no know the local name. It is called shoeblack.

**Interviewer:** So, what if the textbook had the cranium but then in bracket the skull beside it, right? Similarly, what if the textbook had, for people who didn't know what the hibiscus look like, hibiscus and then in bracket shoeblack as the local term?

**Barbara:** It means the same thing, you have the scientific name and the local name.

**Interviewer:** You think that would be a good thing?

**Nyree:** Yea because like people who don't understand aahm Standard English dem know shoeblack and dem know seh a hibiscus that name.

**Interviewer:** Do you have anything else to say about your science textbook? Do you think it can be improved in any other way?

**Tammi:** Yes sir, it can be improve because like for the scientific name that no one is familiar with, they can write it and in bracket write the local name that smaller children will understand and persons reading the textbook will understand what it is saying.

**Interviewer:** What about the pictures and diagrams do you think they are very clear and easily understood?

**Students' Chorus:** Yeah, the diagrams are [pause]

**Nyree:** The diagrams are very clear so we can look on it and have an understanding of what the teacher is saying.

**Interviewer:** Are the pictures in the textbook local things that you know. For example, if they talking about a bird, do they normally use a bird from Jamaica?

**Students' Chorus:** No.

**Interviewer:** How do you feel about that? Do you think they could make more use of local things?

**Students' Chorus:** Yeah.

**Tammi:** Yea for example, like a pigin if dem put a pigin pon di diagram you wudda understand it but if dem put like one duck weh nobody no really used to nobody naw go really understand it.

**Jane:** Like how dem cudda use like the Jamaican hummingbird or doctor bird to demonstrate things instead of using like one, one hawk or suppen else dem cudda just use one [pause] yea cause it's the same bird.

**Interviewer:** So just, just last point what if your textbooks were written just in Jamaican Creole?

**Kameka:** Everything in patwa?

**Interviewer:** Yea, everything in patwa, how would you feel about that?

**Kameka:** How mi wudda feel good about dat? Mi wuddn't feel good bout dat.

**Interviewer:** Why?

**Kameka:** Bout the patwa ting because it's not everybody even tho mi live a Jamaica mi don't really understand everything in patwa.

**Interviewer:** Even when it's spoken?

**Kameka:** Yea like, like di Montego Bay people dem how dem talk mi don't really understand how dem talk.

**Interviewer:** But if they talk Standard English you understand?

**Kameka:** Yea, mi wi understand, yea.

**Interviewer:** OK, what's your view on that Nyree? What if the book or your teacher is using just patwa to talk to you how would you feel about that?

**Nyree:** I wouldn't feel good about that because it's like they are putting us down, they are putting us down because using just patwa that no one else understand but Jamaicans and you can't go out and relate to others with patwa it wouldn't be a good idea.

**Interviewer:** What do you mean by putting us down?

**Nyree:** It seems as if they are lowering our identity.

**Interviewer:** By using patwa?

**Nyree:** Yes sir!

**Interviewer:** Do you have a view on that Barbara?

**Barbara:** Yeah, patwa is all nice and you can like use it to like relate and express yourself more when you are a Jamaican but when you go out internationally you, you ever talk patwa to somebody yet or eva talk like how you live a London, you eva talk patwa to somebody else in the country dat them grow up in and dem a seh what! Weh you seh? and dem no understand?

**Interviewer:** Is patwa a language?

**Barbara:** Patwa, they say patwa is a broken language because it's a mix between English and weh the African language suppen mix up together.

**Interviewer:** Your teacher is signalling for us to close this discussion now. So, I am very pleased that you took the time to have this discussion with me. Thank you all very much and all the best in your future endeavours.



## Appendix B: Transcript of a teacher interview (Upgraded high school)

**Participant:** Carol (pseudonym)

**Interviewer:** Thank you very much for agreeing to participate in this discussion. As you know, having been kind enough to read the information sheet, I am interested in the accessibility of science textbooks to Jamaican students- looking specifically at the extent to which the language of science in textbooks acts as a barrier to students' engagement in science. The purpose of this session is really for me to get in your own words the sort of things you think about your science textbook. Therefore, what I hope to do [pause]. I have a few questions, which I would like us to discuss. Anything you say will of course be very confidential. I will be recording and transcribing this session but it will only be used for my purposes to help jog my memory. You do not have to answer any questions if you do not wish. However, I am hoping you will. In addition, you can use either or both Jamaican Standard English or Jamaican Creole in your discussions. Ummm [pause] I think that is probably all I need to say.

**Interviewer:** How long have you been in your current role?

**Respondent:** One year.

**Interviewer:** OK one year, umm! What made you decide to become a teacher?

**Respondent:** My decision to become a teacher came from [pause] really and truly the love of seeing young men mold into something productive so that they can contribute to the wider society.

**Interviewer:** What would you say is your first and second language?

**Respondent:** [long pause] English, patwa.

**Interviewer:** English is first and patwa is second?

**Interviewer:** How would you describe the role of a science teacher?

**Respondent:** Well, being a science teacher it is, I would say one of the most exciting job because with the science subject you get to relate to everyday life. You get to relate to the things that the students see in their environment; things that they come across in their daily life, like a pound of sugar at home, like walking to school with ahm [pause] respiration, breathing ahm [pause] digestion everything so they can relate to basically everything in science.

**Interviewer:** How would you describe the students' language usage in the classroom?

**Respondent:** Language? The language is mixed with English and patwa. So, you get a mixture all the time, every class.

**Interviewer:** How and when you use Jamaican Standard English and Jamaican Creole in your teaching? Tell me about the challenges of that.

**Respondent:** Alright, basically for me, I always start with the Standard English, but as you go through out the lesson you realise you are losing some students, so because we are all familiar with the Jamaican Creole, sometimes you have to pitch in a little bit here and there where you do a little role play for them to get the fully understanding and for you to engage everybody. To make sure you have every one's attention you use the Creole. But we use both English and Creole throughout.

**Interviewer:** Would you say your students are equally good a Jamaican Standard English and Jamaican Creole by the time they get to grade nine?

**Respondent:** Grade nine? [pause] Some, I would say a percentage of them, like 40%.

**Interviewer:** How does that affect your teaching?

**Respondent:** It affects teaching in that when you have like [pause] your lesson entirely based in all the Standard English, you're gonna lose some students attention because, they are waiting to hear the patwa or the terms that they know in patwa coming out in the lesson so all the time you have to switch to patwa, the Standard English, then back and forth to get everybody involved.

**Interviewer:** Do you think spoken English proficiency is important for success in science?

**Respondent:** Speaking English is proficient in science?

**Interviewer:** English proficiency? Do you think spoken English proficiency is important for success in science?

**Respondent:** Hmm [pause] No, I don't think so.

**Interviewer:** Tell me some more about that.

**Respondent:** Because everything that is in English [pause] in the Standard English you can relate it in patwa. So, I believe that for instance, there is a person who don't know English at all [pause] right? And they know patwa, they can relate to things in patwa. The same things that you are going to teach about soil, the mightn't [pause] soil is like the English word in Jamaica, when you speak in Creole they know it as dirt. If I should go out and say we are going to do dips in the dirt today they are gonna get me the same thing, if I say to somebody in Standard English we are gonna work with the soil today, they will both bring me the same thing so they both will understand.

**Interviewer:** How often do you use your science textbooks?

**Respondent:** Like 50% of the time.

**Interviewer:** In what situations do you normally use them?

**Respondent:** The science textbook good with diagrams, so we have diagrams in it that relate well, so you will get digestive system, you will get like methods of fertilization, you get like the heart so you can see the deoxygenated and the oxygenated blood. They can relate to it because they have one in red and one in blue. So, we use it when we want to relate them to the diagrams.

**Interviewer:** So, when you are introducing a topic? How you do normally introduced it to your class from the book?

**Respondent:** From the book? First, you normally go in and get a brainteaser so you get them involved first. You don't just go straight to the book. And then, after they figure out the topic, you actually by discussion or by brainteaser they figure out the topic you then you can move on to the book, but we normally just don't start with topic from the text book.

**Interviewer:** What are views on the language of science textbooks? Are they written in a way that the students can access them?

**Respondent:** Some. Not all of them, some. Like the integrated science text book for grade nine, I think it is well written for students to understand because it's mostly in pointer form so it don't have those long paragraphs but they put like each thing in pointers or bulletin for them to easily follow.

**Interviewer:** Let us say for example, a student is having difficulties understanding science. Do you think all the textbooks are written for these students to understand?

**Respondent:** No. They are not, because some terms you know because of the Standard English going through out some of the students especially in Jamaica will not understand. The job of the teacher at that time is for you is to relate like the different words to something that they know, to break it down for them so that they can understand it so it's not written for students who you know are not familiar totally with the Standard English.

**Interviewer:** Do you give the students homework from the textbooks?

**Respondent:** Yes.

**Interviewer:** In that situation, how will a student do the homework if they cannot understand what is written in the textbook? How do they work in a situation like that?

**Respondent:** Well, each time you give the homework it has to be something related to what you do in class already. Therefore, the terms that you are giving them as homework now they would know that term already, because it is something that you would have discussed in class. For example, you would say to them list the factors that contribute to photosynthesis. We have discussed the term photosynthesis, they know the definition so then they can relate to it. It is just that they are going home now to sit down and without the teacher to say let us see if they understand it.

**Interviewer:** Are you comfortable speaking Jamaican Standard English and Jamaican Creole?

**Respondent:** Yes.

**Interviewer:** In what context outside the classroom do you use Creole?

**Respondent:** Everywhere! Everywhere!

**Interviewer:** Everywhere?

**Respondent:** Yes! Everywhere (laugh).

**Interviewer:** Do you consider Jamaica to be an English-speaking country?

**Respondent:** Yes. I do.

**Interviewer:** Why? Tell me about it?

**Respondent:** I consider Jamaica to be an English-speaking country in that most persons that you meet, either at work, on the streets, on social media wherever; they know the Standard English and you realize that they stick to Standard English they will go over go over to patwa if they are getting comfortable and know that all right you are a Jamaican, I am a Jamaican so we can talk our patwa cause we like to embrace it. But, they do know that English is our language.

**Interviewer:** Tell me about how you support the language awareness in the classroom? When you are teaching do you separate Jamaican Creole from Jamaican Standard English or do you encourage them to express their ideas in Jamaican Creole?

**Respondent:** Oh, yea [pause] we separate them? We separate them in that we teach them in the Standard English but there comes a time when the patwa will come in. We do encourage them to use them separately and we encourage most of the work or all of the work to be done in Standard English. When patwa comes now in is because you know that within the classroom when we have to do role play or some songs or something we have to embrace our culture in Jamaica because that's what we are known for. So, when we ask them to do songs or so and for you to know that the students understand what was taught we will say to them go and put it in your own words and they will comeback with it in patwa. Some of the same thing that we have taught them in English go over to patwa then we know that exactly they get it. Understand?

**Interviewer:** Yes. How would you mark a student work if they write in patwa? For example, if somebody says to you too much suga no good, would you mark it correct or would you tell them to write in in the Standard?

**Respondent:** No. If the student's say too much suga no good for you then you are going to put language. It's correct but you are going to put language because you want them to use the English. Like I have said before the only time they can express themselves in patwa is like with the role play or [pause] if they going to do a song, so you know we do our reggae songs in patois.

**Interviewer:** What are your views on using Jamaican Creole to teach science?

**Respondent:** Personally [pause] I think it should be present in the textbook and it should be present in the syllabus. Why? [pause] Because, as I have said before, many times you are trying to explain something to the students and they will not totally get it using the English only. But, if you use the patwa they can relate to those words. You might say this is what the word is in patwa and this is it in English. They will better understand how to use the words when they are writing. For example, in patwa one might say "Di day a gwan good". You can tell them that in English it is "This is a good day". In this way, the students will be able to relate their patwa to the English to help them read better. Also, the part of the book that says 'vocabulary' or 'key terms' should have the patwa words beside the English words, so they can take these words from the classroom and to actually practise them back out there in the wider society.

**Interviewer:** Thank you very much.

Appendix C: Student and teacher questionnaire

## Student Questionnaire

School Name.....

Gender: Female  Male

Please tick the correct answer(s) or write your answer in the space provide.

1. Do you like using your science textbook? Yes  No

2. Why do you think that about it?

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3. Which sections of your science textbook do you find most helpful?

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4. Which sections of your textbook do you have the most difficulty with?

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5. How do you think your science textbook could be improved?

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6. How often do you use your science textbook?

At least once a lesson

At least once a week

At least every few weeks

Only when the teacher is away

Hardly ever

7. How do you usually use your science textbook?

For background reading

Answering questions it contains

Making notes from it

Copying diagrams from it

In other ways

8. If you ticked 'In other ways' for question number 7, please describe how you use the textbook.

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9. When do you usually use your science textbook?

In class

At home

Both in class and at home

Questions **10-16** concern the language you use in various situations. Please choose one of the five responses in each case.

**A)** Always Jamaican Standard English

**B)** Mainly Jamaican Standard English

**C)** Always Jamaican Creole

**D)** Mainly Jamaican Creole

**E)** Equal amount of Jamaican Standard English and Jamaican Creole

**Please indicate your answer choice by circling the appropriate letter on the right side of the sheet.**

10. Talking to the science teacher **A B C D E**

11. Talking to other students in science lessons **A B C D E**

13. Talking to friends at break time      **A B C D E**
14. Talking to your family members  
and friends at home      **A B C D E**
15. Talking to parents or guardians      **A B C D E**
16. The language that is most used by  
your science teacher in class      **A B C D E**

***Thank you!***  
***Wilton Lodge***

## Teacher Questionnaire

Please circle the correct answer or write your answer in the space provided.

1. Name \_\_\_\_\_
2. Gender (a) Male (b) Female
3. How long have you been in your current post? \_\_\_\_\_
4. How long have you been a science teacher? \_\_\_\_\_
5. How would you describe the background characteristics of the children you teach?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. How often do you use textbooks in your science teaching?
  - (a) At least once per lesson
  - (b) At least once per week
  - (c) At least once every few weeks
  - (d) To cover absence
  - (e) Hardly ever
7. How do you normally use the science textbook?
  - (a) Background reading that you do in advance of the lesson
  - (b) Making notes for your use
  - (c) Using the answers to questions at the back of the textbook for correcting student work
  - (d) As a source of diagrams to copy on the board



(e) In other ways

If you use the science textbook in another way, please explain further.

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8. How do you introduce material from the textbook to your class when you use it?

- (a) Discuss it with them
- (b) Pick out key words
- (c) Note taking
- (d) Brainstorming
- (e) Summarizing activities

**Questions 9 to 13 concern the language you use in various situations. Please choose one of the five following responses in each case.**

- (A)** Always Jamaican Standard English
- (B)** Mainly Jamaican Standard English
- (C)** Always Jamaican Creole
- (D)** Mainly Jamaican Creole
- (E)** Equal amounts of Jamaican Standard English and Jamaican Creole.

Indicate your responses by circling the appropriate letter on the right hand side of the sheet.

9. Talking to students during lessons      **A B C D E**

10. Talking to colleagues      **A B C D E**

11. Talking to family members      **A B C D E**

12. Talking to friends outside of school      **A B C D E**

13. When disciplining your students      **A B C D E**

14. Do you think science textbooks are easily understood by your students

**YES      NO**

15. If you said no at question 14, what would make the textbooks easier to understand?

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16. What do you think about the use of Jamaican Creole for teaching science

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**Appendix D: Cloze test extract.**

**Name:** ..... **Date:** .....

**School** ..... **Gender:** .....

**Instructions:**

In the following three passages some words have been left out. First read over the whole passage and try to understand what it is about. Then try to fill in the blanks with words that would complete each sentence. It takes only one word to fill in each blank. You may stop answering questions at any time during the test.

## Unit 4

### Human Reproduction and Responsible Living

#### ***Alcohol Abuse***

In the study carried out with post-primary ....., alcohol was more than twice as ..... to be abused as other drugs. .... greatest number of children were involved .....grade 7 (22.9% of girls and 37.5% of boys) . .....there was a reduction, year on ....., up to grades 12 and 13 where they were ..... less than 1%. At all grade levels, .....of alcohol was higher among boys ..... girls.

#### ***Effect of drinking***

A little alcohol taken occasionally ..... food can help a person to relax ..... . But too much alcohol can affect ..... brain so actions cannot ..... controlled properly. After more alcohol, the ..... may become slurred and walking is ..... Additionally alcohol can cause the person ..... lose consciousness.

A person who regularly ..... too much can damage their liver, ..... is an extremely important organ for ..... the whole body running properly. . ..... liver may be poisoned and may ..... cancer. This can cause death.

Pregnant ..... are advised not to drink any ....., especially in the first three months ..... pregnancy, as this could harm their ..... baby. Parents should also not give alcohol ..... babies to help them sleep as ..... can cause confusion and bad habits ..... on.

As the person who is ..... gets energy from the alcohol, this .....mean that they are not getting ..... proper balanced diet. Yet they put .....weight around the abdomen: this is .....a 'beer belly'. Excessive drinking also causes .....in family life and in the ..... When people are drunk they lose ....., can become violent and hurt other .....

Alcohol relaxes a person so they ..... be more likely to be sexually ....., or to take drugs that they ..... otherwise refuse.

Alcohol makes a person ..... they can do things they really .....,  
such as drive carefully. Drunk drivers ..... too many risks. Many road accidents  
..... caused by people who are driving ..... drunk. They may even  
cause accidents ..... which they or others are injured ..... killed.

## Unit 6

### Our place in the Universe

#### ***Volcanoes in the Caribbean***

The line of islands in the eastern ..... was formed from volcanoes long ago. .... of them are now dormant (not erupting), but ..... are still active. For example, Dominica ..... nine active volcanoes, and there was ..... major eruption of Mount Soufriere in ..... in 1979. A lot of ash and ..... came out of the top of ..... volcano, which is called the **crater**. ..... explosion was heard on nearby islands.

#### ***A case study: Montserrat***

..... volcanic area in the south of ..... island is called Soufriere Hills. The ..... peak that erupted is called Chances ..... . This has been dormant for 3000 years ..... it erupted in July 1995. There were ..... few warning signs such as small ..... and eruptions of dust. The population ..... the island 11000 people, were evacuated.

There ..... then further, worse, eruptions in 1997. The ..... of lava from the eruptions destroyed ..... and buildings and wiped out whole ..... over the southern half of the ..... The capital, Plymouth, was covered in ..... of ash and mud. There was .....eruption in July 1998.

Volcanic activity has ..... less in the past few years. .... are now returning, but the island ..... still on alert.

#### ***What causes volcanoes?***

Volcanoes are found, ..... example, at the edge of continents ..... plates meet. One of the plates ..... forced down below another. As they ..... is pushed down it becomes very ..... . It causes hot liquid material, magma, ..... be forced up the centre of ..... volcano (the vent), and out as lava.

As ..... lava, ash and dust are ..... sent high up into the air ..... an explosion of gas is heard.

..... lava builds up on the sides ..... a volcano to make the characteristic ..... shape.

***What are volcanoes like inside?***

If the lava is fairly ..... then the gases that are trapped ..... it can escape easily. But if ..... lava is thick then the trapped ..... explode with a loud noise and ..... large cloud of ash and pieces ..... rock are thrown out. The pieces ..... rock are called 'bombs'. Lava can ..... 11000C and can travel at 100km/h.

When a ..... is dormant there will be little ..... You may be able to see ..... mud pools, or steam rising from ..... Earth, or you may be able to feel the warmth of the magma just under the surface of the soil or rock.

## Unit 3

### Living Things Reproduce

#### *Reproduction in vertebrates*

##### *Fish*

Fish produces enormous numbers of eggs: an ..... of 6 million a year. The ..... is the ocean sunfish, which lays 30 million ..... at a time. This is because ..... a few eggs will survive to ..... For example, only 3 out of 100 000 fertilised mackerel eggs ..... to become adult fish.

In some ....., such as mouth brooders, the parents ..... for the young. Fertilised eggs develop ..... the mouth cavity. The young fish ..... close to the parents. If an ..... comes near, the young go back ..... the mouth where they are protected. .... seahorses also brood the young in a ..... pouch.

##### *Amphibians*

Amphibians also have external fertilisation, ..... the eggs have more yolk for ..... early development. Some tree frogs produce ..... foamy liquid, which hardens to protect ..... eggs as they develop. A few ..... give some care to their young. .... example, a male Darwin's frog swallows ..... eggs into his throat until they ..... and pop out. A stomach-brooding ..... swallows her eggs: they develop in ..... stomach to jump out as little ..... A female midwife toad lays eggs ..... the male's hind legs. He carries ..... until he takes them to water ..... the tadpoles to hatch and swim .....

##### *Reptiles*

Fertilisation is internal and the eggs ..... food supplies and a shell that ..... some protection. Fewer eggs are laid. .... example, a female green turtle lays ..... than 200 eggs, and incubates them in ..... sand. A few reptiles care for ..... young. For examples, many crocodiles make



..... The mother guards the eggs until ..... hatch. She then gently carries the ..... to water.

Most lizards lay eggs, ..... a few kinds produce live young, ..... the parents do not look after .....

***Human are Mammals***

Humans are mammals. We have a ..... of hair and the young are ..... alive and give milk from the ..... of the female. We also have ..... ears and our bodies are divided ..... two parts by a sheet called ..... diaphragm. We are also special: we ..... upright, can talk and take a ..... of care of our children.