BUILDING CONDITIONS AND STUDENTS' ATTAINMENT IN JAMAICA

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Abstract

A growing body of research has established that there is a link between building conditions and students' academic performance--if the condition of the school facility is good the academic scores of students are likely to be higher than those schools that are in a bad state. However, there have been no previous studies into the relationship between building condition and students' attainment in countries like Jamaica; countries that are tropical, and have fast rising populations, low GDP, and where a poor performing economy is the norm. The aim of the study was to examine the findings of previous researchers to determine if the same variables they found that were impacting student attainment were also affecting the Jamaican education system in light of some of the students' low academic performance. The sample was 83 public high schools that offered Mathematics, English Language, Principles of Business, Principles of Accounts, Social Studies and Visual Arts. The survey instrument used was based on that developed by Cash (1993), however it was modified to accommodate the Jamaican context. After pilot testing, the high school principals were given the revised Commonwealth Assessment of Physical Environment (MCAPE) to assess building conditions. Their assessments were validated via a number of visits. Student achievement was measured by final examination scores collected from the Ministry of Education and derived from Caribbean Secondary Education Certificate Examination (CSEC) results. The variables were analysed using descriptive statistics, non-parametric tests, and multivariate analysis which were used to address the research questions. The important findings were that eight of seventeen variables relating to school facilities showed strong, and usually statistically significant at $p < .05$, correlations with attainment as did five of the six variables relating to noise generating facilities. There was an unexpected finding with regards to building age: an original contribution to knowledge of this research is that, contrary to studies in developed economies, it

is older schools in Jamaica that tend to be in better condition; a finding school principals attribute to the assistance of Past Student Associations. The main issue now facing the Jamaican education system is that students' academic performance are extremely low overall. This has challenged school administrators to determine the cause with a view to correcting this problem. This research will aid in solving the problem by highlighting possible factors that are associated with poor performing schools in Jamaica. The findings of this research will help to address built environment related problems in the education system. The research suggested other areas that could be researched and therefore can be used to determine the design and maintenance needs that have the greatest impact on the learning process.

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I must express my gratitude to the librarian at the University of Technology, Jamaica. Specifically, Miss Glenda Dallin, her unwavering support is noted. I owe a debt of gratitude to my friends and staff at the Facilities Management Department who without reservation carried the burden of the department when I was away on study leave. The suggestion of the former President the University of Technology, Jamaica (Dr. Rae Davis) who encouraged my interest in this field of study and advised me that there was a need for research in this area. Also, I am indebted to Dr. Audrey Thomas, the former Head of School in the Faculty of the Built Environment, University of Technology, Jamaica, who endorsed my research topic.

Finally, I owe a debt of gratitude to my wife, who spent many lonely nights while I was away from home. Her invaluable support and confidence helped to motivate me; without her support this thesis would not have been possible.

I dedicate this thesis to my family, particularly Mr. and Mrs. Robert Roper; my father and mother; Kenora Stepheno Cle-Patra Roper, my wife, and my daughter, Annabelle Christina Roper.

Author's Declaration

I confirm that this thesis is the sole work of the author.

O'Neil Ryan Roper

Chapter 1

Introduction

Background

In spite of numerous interventions from government, communities, and donor agencies the Jamaican education system continues to underperform. The poor performance was highlighted in the report of a task force commissioned by the former Prime Minister of Jamaica, Percival James Patterson. The 14-member Task Force on Education Reform (TFoER) prepared an action plan consistent with a vision to create a world-class educational system, capable of generating the human capital necessary for Jamaican citizens to compete in the global economy (Davis, 2004). The TFoER revealed several noteworthy, achievements including:

- National curricula and standardized testing programmes at the primary and secondary levels.
- The provision of a space in public primary level schools for every Jamaican child 6-11 years, as well as a space at the secondary level for more than 70% of children 12-16 years.
- The more than 22,000 teachers, some 80% of whom are trained, who continue to provide yeoman service, despite the many challenges.
- The more than 12,000 persons who provide voluntary service by serving on school boards.
- The thousands of parents who support schools through Parent/Teachers Associations and other community groups.
- Other support programmes such as school feeding and textbook programmes.

However less savoury facts also came to light that:

- Less than one-third of the children entering Grade 1 were ready for the primary level education.
- 30% of primary school leavers were deemed illiterate.
- Only 20% of secondary graduates had the requisite qualifications for full employment or entry to post-secondary programmes.

The Annual Progress Report on National Policy Goals in 2003 revealed that:

- Only 25% of students left Grade11 with a pass in Caribbean Examination Council (CXC) English Language.
- Only 17% left with a pass in Caribbean Examination Council (CXC) Mathematics.
- Only 65% of adults are functionally literate with 15% at the basic literacy level and that 20% of adults are illiterate.

With respect to buildings the task force report also revealed the following:

- 20% of school buildings needed major repairs and a further 38% needed minor repairs.
- Less than 50% of schools had adequate toilet facilities for students.
- Over 50% of all schools do not have a security fence or wall at the perimeter.
- Nearly 20 % of pupils needed seating and writing surfaces.
- Schools require specialist facilities such as science laboratories, libraries and secure computer storage.
- There was inadequate classroom space to allow for different teaching options including mixed ability groupings, as well as inadequate staffrooms, administrative/office space, sick bays and limited facilities for the physically challenged.

- Inadequate ventilation, lighting, water supply, sanitary facilities and facilities for play areas and co-curricular activities are not provided in many private and public schools; there is a lack of a clean green environment.

Based on the information garnered from the Task Force on Education Reform (TFoER), underperforming students suffer from inadequacies in the physical facilities of schools that were assessed. This researcher therefore investigated whether the conditions of school buildings impacts the level of attainment of high school students in Jamaica. The researcher believes that this thesis is timely and necessary as the Jamaican educational system underperforms in spite of numerous interventions from government, communities, and donor agencies. Moreover the system is now said to be in transformation mode. This thesis aims to improve the body of available information that government and administrators can use to make informed decisions that will influence the transformation process. The poor performance was alluded to in this quotation from the former Prime Minister, Bruce Golding in his budget debate presentation of April 20, 2010: "Over 70% of the students who leave school at age 16, numbering some 38,000, have passed less than three subjects; 28,000 not even one" [1]

In a *Gleaner*[2] article by Reid (2012), focus was placed on psychosocial assessments conducted on almost 6000 students who had failed the Grade Four Literacy Test four times and conclusions were drawn that their ability to learn is being hampered by environmental and other social factors. The findings from the assessments revealed that more than 80 per cent of the

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[1]Budget debate presentation Tuesday April 20, 2010 by the Hon. Bruce Golding, M.P. Prime Minister available at http://www.japarliament.gov.jm/attachments/419_Budget%20Debate%202010-2011%20by%20the%20Hon.%20Bruce%20Golding.pdf

[2] The Gleaner Company Ltd is a newspaper publishing enterprise in Jamaica. Established in 1834 by Joshua and Jacob De Cordova, the company's primary product is The Gleaner, a morning broadsheet published seven days each week.

failing children were experiencing difficulties learning, not because they cannot learn, but because of external factors beyond their control. "It should also be assumed from assessment findings that with the majority of students, family and community; social and physical environments are additional forces impacting their students' performance." (Alternative Secondary Transitional Education Programme [ASTEP] summary provided by the education ministry). Education Minister Ronald Thwaites described the results as a tragedy. "I'm not surprised at these figures." "It confirms [previous] observations."

Though the population for this assessment was primary school students, the researcher believes it is important to note that even at this level environmental factors, which would include the physical infrastructure of some of the schools, were highlighted as a contributing factor to the continued poor performance of students.

Introduction

The Jamaican education system was instituted to provide education for its citizens. It is expected that the system will provide adequate training that will facilitate Jamaican citizens operating and competing effectively in a global environment. Reviews by the Task Force on Education Reform and Vision 2030 for Jamaica (Planning Institute of Jamaica, 2009) have revealed that the education system is failing with less than 25% of students leaving secondary school with two subjects or less. One of the key problems identified is the less than desirable state of the physical infrastructure, particularly school buildings. School buildings are designed and constructed to house educational operations for staff and students. However, in some cases, buildings have suffered from poor maintenance systems and natural disasters, particularly hurricanes. These factors have left some buildings in a poor state of repair and continue to cause discomfort to students and staff. The state of the disrepair of many of these buildings and other facilities is suspected to be hindering the performance of Jamaican students, which has been the case with many other developing countries.

Beynon (1997) citing Heyneman & Jamison (1980) reported that research has provided evidence to support the theory that a low level of learning among children in developing countries can be partly attributed to poor and inadequate facilities. Beynon (1997), also stated that "the overall conclusion, which is being reinforced as new research results come in, is that while school building and furniture do not teach (parents, teachers, textbooks and supplementary learning materials do) soundly built, maintained and adequately furnished and equipped buildings have a profound positive effect on both participation and achievement." (p. 22). Research conducted in Nigeria and India also concluded that facilities like buildings, separate classrooms and student's desk determine the organisation of the teaching/ learning activities and that these factors do influence the learner's achievement. Fuller (1990) also concluded after his review of numerous international research on environment and building that physical facilities are important.

In The United States and United Kingdom previous studies have examined the impact of building condition on students' attainment and behaviour. One such study was done in the United States by Cash (1993) which was replicated at least four times. The results of the studies have shown that poor building conditions affect students' performance. The rationale supporting this thesis was that school buildings that are in good condition should facilitate good academic performance from students. Therefore it is expected that students would perform at a lower standard as the condition of the school building worsens and that poorly maintained buildings are hindering the performance of students. Consequently, I have undertaken this research to determine if the variability in school building conditions in Jamaica is associated with the performance of our students. I have adopted a structural approach in doing this thesis even before exploring the literature. In addition, inadequate information was found locally relating to the topic of this thesis. The approach taken by this research was employed because of the limited documented evidence of building condition, which includes poorly maintained and modified buildings.

International studies, predominantly in the USA and the United Kingdom have identified that a strong relationship exists between the condition of educational facilities and student academic achievement and behaviour. Does this relationship also apply in the Jamaican context? If so, what is the extent of this link? What accounts for this link and what other unique factors may be affecting the performance of the Jamaican student? This thesis attempted to answer these questions. The thesis was motivated by the poor state of some educational facilities, less than desirable academic achievement of students and the increase in behavioural problems in high schools in Jamaica, all of which present challenges for the education system. The ultimate objective of this thesis was to determine if there were any differences in student's performance based on variability in building condition. In so doing, a body of knowledge would be developed that would be applicable to the Caribbean in general and specifically to the Jamaican context. It is hoped that the findings from this research will play a major role in the transformation of the education system which is now underway.

Structure of the Thesis

This thesis comprises six chapters following this introductory chapter. Chapter two provides a critical review of the key studies into building condition, student's attainment and their behaviour and identifies gaps in the existing body of knowledge. The first part of chapter two discusses the background theory behind this thesis, focusing particularly on defining and explaining concepts such as building condition, student's attainment and their performance. Next, chapter two provides a critical review of research that has been conducted into building condition. This is followed by sections that outline specific elements relating to building conditions and performance requirements of buildings. The specific elements of building design to be discussed in the thesis are presented next, highlighting gaps in knowledge and identifying areas for further research. The following section presents literature related to the condition of the facility especially as it relates to the grounds and the furnishings. Literature related to the studies on student behaviour is outlined next. The impact of leadership on school facilities is discussed in the following section and definitions of Facilities Management are presented in the next section. Chapter two concludes with a discussion on the evolution of the Cash Model that was utilised as a basis for this research.

Chapter three gives an account of the methodology used to conduct the study including the types of research and the research design employed. It describes the populations studied, lists the data collected for analysis, describes the pilot study, the modifications made to the Cash Model in order to contextualise it for Jamaica and the administration of the modified questionnaire. Chapter four gives an analysis of the data collected on school population, school age, structural variables (those referring to design) and cosmetic variables (those referring to condition) used in the research. Chapter four concludes with an analysis of qualitative data collected on non-facility related factors that may also affect student attainment, as well as a verification of the questionnaire results by site visits.

The findings of the thesis are presented in chapter five, specifically those relating to building age, school design and structure, and building maintenance and cosmetic variables. In addition, attempts to rank the significance of variables on each classroom subject are discussed giving the significance of independent structural variables and cosmetic structural variables respectively. A discussion of the findings of the effect of socio-economic factors including the impact of school alumni on building condition is also presented. In addition, chapter five discusses the findings of the thesis and specific conclusions are given. Contributions of this thesis to the body of knowledge on Facilities Management in Jamaica are listed. The chapter ends with a discussion of the limitation of the thesis.

Chapter six makes specific recommendations based on the findings of the research that addresses standards and building design and maintenance, strategic planning for school facilities, facilities audit, proposed institutional framework, regulations and inspections and training. The thesis ends with overall recommendations.

Figure 1.2 shows the structure of the thesis which apart from the background to the study includes five sections, the literature review, a description of the research methodology employed, analysis of data from site visits and statistical analyses, findings and conclusions and recommendations and implementation strategy. See Appendix A for a summary of acronyms.

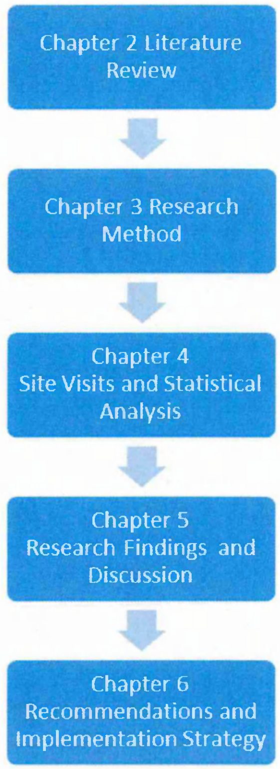

Figure 1:1. Structure of Thesis.

Setting

Jamaica is an island of the Greater Antilles, 234 kilometers (145 mi) in length and as much as 80 kilometers (50 mi) in width, amounting to 11,100 square kilometers (4,300 sq mi). As seen in figure 1.1, Jamaica is situated in the Caribbean Sea, about 145 kilometers (90 mi) south of Cuba, and 190 kilometers (120 mi) west of Hispaniola, the island comprising the nation-states of Haiti and the Dominican Republic.

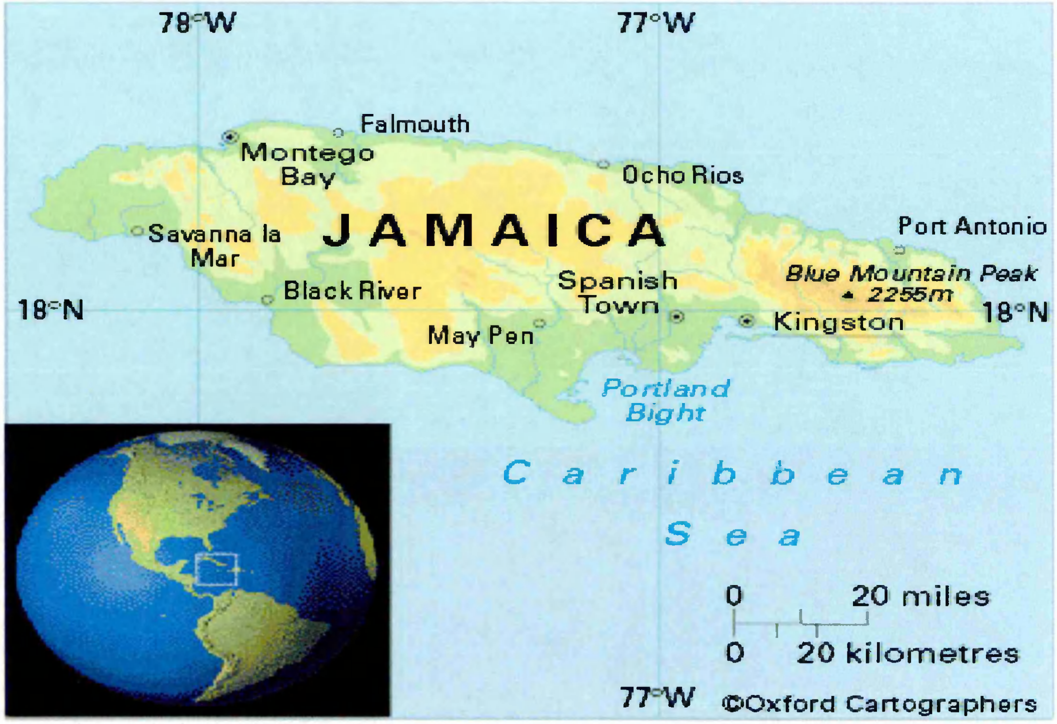

Figure 1.2. Map of Caribbean and Jamaica.

Source: http://en.wikipedia.org/wiki/Jamaica

Jamaica has a population of almost 2.8 million and is ranked third among 75 countries as a natural disaster hotspot (Dilley, Chen, Deichmann, Lerner-Lam & Arnold, 2005).

Challenges in the Education System

The Caribbean Secondary Education Certificate (CSEC) is one of the major mechanisms for certifying students at the secondary level within the Caribbean region. But trend analysis, based on data from the Caribbean Examinations Council (CXC), has shown an inverse relationship between student registration and performance. In addition to the students who fail the examination, there are a significant number of students who register for, but do not sit the examinations. The Task Force on Educational Reform Report (Davis, 2004) identified a target for 2015 of approximately 60% of students in the age cohort passing at least five subjects in the CSEC exams inclusive of Mathematics and English.

There is, however, concern regarding the country's ability to meet this target considering that at present we are only achieving 19%. In addition, the 2012 CSEC examination result showed a decline in performance.

Education Minister, Ronald Thwaites, has described the performance of students in the most recent Caribbean Secondary Education Certificate (CSEC) examinations as shocking. Thwaites, who read out overall performance in Mathematics and English Language, said the country will have to confront the 'critical statistics' which point to a decrease in the percentage of pupils who pass the exams.

He said 46 per cent of the students passed English Language, a result which he called shocking when compared with a pass rate of 63.9 per cent last year.

The minister said 31.7 percent of students who sat Mathematics attained passes, a slight decrease from 33.2 per cent last year.

We are very disappointed in these results.... The country has to come to grips with these realities.

He said if the performances are to increase the country must seek to properly educate its pupils at the earliest possible age. (Luton, 2012).

A number of strategies are currently being pursued by the Ministry of Education to address the problem of low performance. These strategies span early childhood to the tertiary level of the system. Although moving in the right direction, these strategies are limited in scope. Since the establishment of the National Education Inspectorate only approximately 30 schools to date have been inspected. Moreover, the report does not give much attention to the physical state of school facilities.

The issue of low performance at the secondary level is a complex problem which requires a multi-disciplinary approach and should be analyzed within the context of 'a systems approach'. For that reason, the entire education system should be reviewed as a whole consisting of several parts with a view to understanding how each part impacts the other. A holistic, profile-driven, seamless approach is being proposed. The aim is to establish a relevant, high-quality, seamless education model, which is responsive to the needs of all students. The seamless element of the model is critical to support easy transition of our students from one level of the system to the next in the pursuit of lifelong learning, while the profile-driven characteristic is geared towards achieving desired student outcomes (Reid, 2011).[3]

The TFoER stated that "School capacity and the state of the physical plant require rationalisation, upgrading and expansion to internationally accepted standards with the needs of learners at the core." (Davis, 2004, p. 14). International studies, predominantly done in America and the United Kingdom, have identified a strong correlation between the condition of educational facilities and student academic achievement and behaviour. The researcher thought that a similar correlation also applied in the Jamaican context, allowing for other intrinsic Jamaican factors that may be affecting the performance of students. The poor condition of school buildings is more prevalent in developing countries. Beynon (1997) cited a pilot survey that was jointly undertaken by UNESCO and UNICEF of school conditions in the least developed countries (LDCs). The survey revealed that the physical conditions of the schools were deplorable. There were instances where the sanitary facilities were unusable due to a lack

[3] Excerpt of an article by Mr. Ruel Reid, chairman of the National Council on Education. Mr. Reid is also Principal of Jamaica College.

of or insufficient cleaning, which was a condition prevalent in both urban and rural areas across one third of the countries surveyed. The poor conditions extended to schools that would be considered as modern, equipped schools, where they lacked piped water, electricity, first aid kits or even a canteen. It was also noted that over one third of the classroom in several countries had poor ventilation or lighting. Earthman et al. (1995) also found that a number of the classrooms had insufficient lighting and ventilation due to insufficient windows or poorly designed and constructed buildings.

According to school heads in many of the least developed countries surveyed, 40% or more pupils attended schools that were in need of significant repairs or complete reconstruction, while 60-90% of children in one third of the countries were in schools without regular maintenance. School heads also reported that the conditions of housing, toilets, classroom furniture and supplies deteriorated over the last five (5) years (Earthman et al., 1995).

Research Process

The hypotheses that have been evaluated in this research were

- H_1 = There is no difference in student attainment between new schools, average aged schools, and old schools;
- H_2= There is no difference in student attainment between schools with differences in cosmetic conditions;
- H_3 = There is no difference in student attainment between schools with differences in structural design.

A deductive research method has been used for this research since it facilitated the development of conceptual and theoretical structures prior to testing through empirical observation (Gill & Johnson, 2005). A deductive research method[4] includes descriptive and rational research using correlation[5] and casual – comparative methods using surveys and questionnaires (Bastic & Matalon, 2004). A theoretical framework has been developed by Cash (1993) for this research topic which will be discussed in more detail in chapter two. This model was replicated to suit the Caribbean context, particularly in Jamaica. The following are limitations of the research:

- The research was conducted in secondary level schools only.
- The building survey questionnaire was administered to principals who do not necessarily have a background in the built environment. As the survey was self-administered there may be limitations regarding the objectivity of the data (Cash, 1993).
- There was a lapse in time between the assessment of the building conditions and the collection of results used to make comparisons.
- It was impossible to identify all the variables that could affect student achievement and behaviour. This could result in a large error variance and a less significant correlation in variables of interest.
- CSEC results were the only method used to estimate student attainment. Achievement in other areas such as sports, art and community service were not addressed in this thesis.

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[4] Deductive research method entails the development of conceptual and theoretical structure prior to its testing through observation (Gill & Johnson 2005).

[5] Correlation is the relationship between two variables with the major interest being the direction and degree of the relationship (Bastic & Matalon, 2004).

It was assumed that the survey/research was conducted in a typical school year with no significant social, political, natural or economic upheaval occurring. This research is cross-sectional.

Importance of the Research

In his 2010 budget speech, the then Finance Minister estimated that the economy contracted by 2.7% in 2009 and blamed this on a significant reduction in exports due to the global recession, as well as weak domestic demand and lower consumption as a result of falling real incomes, increased unemployment and reduced remittance flows (Shaw, 2010). He explained that in order to address social ailments such as poverty, high unemployment and a high crime rate the government is pursuing the Partnership for Transformation, a critical alliance that embraces the government, private sector, trade unions and academia and which seeks to enhance social dialogue, create shared vision, identify national goals and build consensus on the actions that are required for social and economic transformation. As part of this promised transformation the government has focused on education and training as one of the key issues that needs to be addressed. The 2010-2011 allocation to the education sector amounted to 14.56% of the national budget at JA$73,367,319,000. Additionally the government has expanded the School Feeding Programme which has moved from feeding 113,000 students in 2007/08 to a targeted 220,000 students in the fiscal year 2010-2011 (Shaw, 2010).[6]

The fact that Government has identified education and training as one of the areas on which focus needs to be placed in order to address the issues of prosperity would suggest that they recognize the importance of student attainment and their preparation for employment.

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[6] Opening Budget Presentation to Parliament by Honourable Audley Shaw, MP and Minister of Finance and the Public Service.

Identification of any factor that would prevent students from performing would be critical information for government in order to implement interventions. Therefore it would be relevant for this researcher to identify whether the physical condition of school facilities has an effect on the attainment of students.

The Researcher

I have been interested in topics related to building construction since 1987 when I attended the Dinthill Technical High School where I studied building technology. In 1991, I attended the College of Arts, Science and Technology (CAST) which was later to become the University of Technology, Jamaica (UTech) and in 1994 graduated with a diploma in quantity surveying. Subsequently, I worked with general building contractors for three years, while studying part-time to gain a degree in construction engineering and management studies. After completing my first degree, I gained a Master of Business Administration (MBA), at the University of New Orleans in 2002. With my educational background in building construction and experience with the physical facilities at institutions, I began exploring the possibility of doing research on school conditions and students' attainment.

I have been a Senior Director at the UTech since 2002, where my responsibilities include preparing and maintaining an environment that facilitates learning. Prior to working at the university, I worked with a private company that had won many government contracts through tendering for the renovation and restoration of several public school buildings including primary, all-age, secondary schools, and universities. My work experience and my desire to improve the plethora of building-related problems that challenge the Jamaican education system have been sharpened by years of experience with school buildings and facilities and especially after reading the TFoER that was made available to the public in 2004.

In 2005 after searching for a research program in which to to participate, I came upon the Sheffield Hallam University, Doctor of Business Administration in Facilities Management that facilitated research into the built environment and students' performance by using students' academic scores and behavioural patterns as measures. This study actualizes the desire to investigate the impact of built environment and students' attainment in the Jamaican system.

History of the Education System in Jamaica

The history of education in Jamaica is intertwined inextricably with the island's colonial past. Before emancipation in 1834 there was no formal education system. Only the sons of white colonists were educated. They were sent back to England for training or privately tutored. There were a few schools founded by Christian missionaries that would accept coloured students, but the curriculum was centred mainly on "religion and the virtues of submission" (StateUniversity.com, 2014). Education for girls was not heard of at this time and it was not until 1770 when Wolmer's Free School initiated a modified curriculum for girls that was designed to prepare them for running a home or for employment as seamstresses and mantuamakers." (StateUniversity.com, 2014).

After the abolition of slavery in 1834, missionary societies "developed a system of elementary education for the newly freed slaves" (StateUniversity.com, 2014). Schooling focused on preparing children "for eventual employment as estate workers" (StateUniversity.com, 2014). The curriculum was elementary and consisted of "reading, writing and arithmetic with some religious training and occasional geography and history instruction. In addition, boys were given training in agriculture and other manual arts, and girls received lessons in sewing and domestic science" (StateUniversity.com, 2014). "This system was taken over by the colonial government beginning in the 1860s" (StateUniversity.com, 2014).

As the relative number of British people in Jamaica began to decrease, it became necessary to move native Jamaicans into certain intermediate occupations, and this resulted in growth in the secondary school system and the creation of government scholarships for university study abroad (Wilkins & Gamble 2000) as cited in StateUniversity.com (2014).

Social unrest, including protest marches provoked by widespread unemployment in the 1930s, led to the commission of two seminal reports on social conditions at the time. They are the Moyne and Kandel Reports. The Moyne Report came out of the West Indian Royal Commission which was set up to hold an inquiry "into the social, economic, and educational conditions underlying the unrest" (StateUniversity.com, 2014). The report concluded:

> A lack of central control over the primary schools was as a result of inefficiency in administration. It also pointed out that there was a lack of correspondence between the schools' curricula and the needs of those living in Jamaica. The report recommended, among other things, that the curriculum be modified to include courses in health and hygiene. (StateUniversity.com, 2014)

Interestingly, the report also recorded the need for good school facilities to be implemented with "buildings, sanitation, water purity, and school equipment" being brought to the 'modern' standards of the day (StateUniversity.com, 2014).

The Kandel Report was produced by a committee convened to survey and help upgrade secondary education in Jamaica (Pollack, 1993). It was chaired by Isaac Leon Kandel (1881-1965) who was a leading comparative and international educator and "a leading proponent of the school of thought in comparative education known as historical-functionalism" (Pollack, 1993).[7] It identified an "existing harsh socially segregated education system with its class and colour configurations." (Whiteman, 1994) as cited in (StateUniversity.com, 2014). The report addressed "the educational, social, and economic conditions in the colony" (StateUniversity.com, 2014) and "focused on establishing a system of post-primary education" (StateUniversity.com, 2014) that would ameliorate that problem. Unfortunately the problem of social segregation within the Jamaican educational system is still referred to by current educational researchers and reformists.

Education in Jamaica is currently administered by the Ministry of Education and Youth through its central head office and six administrative regional offices. The Honourable Minister of Education has policy responsibility for the Ministry and the Permanent Secretary is the administrative head. Formal education comprises the early childhood, primary, secondary and tertiary levels and is provided by government solely, or in partnership with private providers, churches or trusts. The private sector participation in the provision of formal education is approximately 85 per cent at the early childhood level and 5 per cent at both the primary and secondary levels.

Access to Education in Jamaica

Successive governments have tried through social legislation and enactments to remedy the existing inequities in access to quality education. These have included "the establishment of the Ministry of Education and the Education Act of 1965, to the New Deal in Education 1966,

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[7]"The basic idea of this school of thought of historical - functionalism is that education systems do not operate in a vacuum. They are intertwined inextricably with other social and political institutions and very often can best be comprehended by examining the historical, cultural, political, social and economic environments and contexts." (Pollack, 1993).

the 70:30 policy for reserving secondary places for public primary schools, the compulsory attendance policy, the upgrading of junior high schools to full secondary schools" (Holness, 2009) and the removal of "exclusionary fees"[8] from the primary and secondary level. There has also been international assistance and agreements with the focus being on expanding access to education.

The problem of access to education is not so severe at the primary level, where compulsory attendance is required by law and free public primary education has existed for at least 100 years. Additionally at the primary level the GOJ provides the core workbooks and reading materials. Students are provided with nutrition and parents who fall within the PATH (Programme of Advancement Through Health and Education) social safety net[9] are given conditional cash transfers in support of the education of their children. Secondary level education is offered to over 300,000 students, in the age group 12- 16 years in grades 7-11. There are five types of institutions offering secondary education All-Age, Primary and Junior High which terminate at grade 9, High Schools, Technical, and Agricultural schools offer five years of secondary education, terminating at grade 11.

Internationally low access to primary education is a major problem. Knapp, Noschis & Pasalar (2007) revealed that over 113 million children do not have access to primary education,

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[8] An exclusionary fee is considered to be any fee that if not paid would deny the student access to the core service of the school or any other service critical to the education of the child. The policy of the GOJ is that primary education is free and no child can be denied access for inability to pay any auxiliary fee imposed by the school for development, special services or goods. The policy is the same for secondary schools except that auxiliary fees are usually much higher than those at the primary level and can be prohibitive to some parents, and thereby exclusionary.

[9] The Programme of Advancement Through Health and Education (PATH) is a conditional cash transfer (CCT) programme funded by the Government of Jamaica and the World Bank and is aimed at delivering benefits by way of cash grants to the most needy and vulnerable in the society.

and the international community has taken note of this immense problem by proclaiming it as the second of eight Millennium Development Goals: "To achieve universal primary education." (United Nations, 2000). According to Beynon (1997), on a global scale, the amount of educational space needed is growing due to continued increase in population in all but a few countries; "it is increasingly accepted that basic education must be provided to all children as well as young and middle-aged adults who seek it." (p. 19). This phenomenon continues to put pressure on the Jamaican Education System. The solution therefore is to create physical facilities that respond to a variety of criteria; they need to be functional, economical, structurally sound and attractive (Beynon, 1997).

School Infrastructure

One of the last major investments in education infrastructure was in 1966 when the Government of the day, borrowed US$6m from the World Bank for the establishment of 50 Junior Secondary Schools, the expansion of the College of Arts, Science and Technology, and the Jamaica School of Agriculture. In 1971 the Government obtained another loan from the World Bank for US$13m to extend the 50 junior secondary schools to full secondary schools, construct 12 new junior secondary schools and to construct a new teachers' college. The Minister of Education, Andrew Holness, in his 2009 Sectoral Debate addressed the need for attention to be placed on existing physical infrastructure and building new school buildings. He stated:

> Our investment in upgrading and refurbishing existing stock is miniscule compared to the level of depreciation. This year we are building 4,210 new spaces (6 new schools) and we are upgrading and expanding 4,450 spaces in existing infrastructure at a projected cost of JA$2.8 billion. This pales in comparison to the numerous requests and complaints directed to me daily from principals and parents regarding the physical condition of their

school plant. Building more schools and improving the ones we have will increase access but it will also increase quality. (Holness, 2009)

The Government of Jamaica (GOJ) has committed to phasing out the shift system[10] by building, refurbishing and replacing at least 100 schools thus hoping to end the bottleneck experienced at the juncture between primary level and secondary level. It is estimated that 30 new high schools need to be constructed and 10 schools need to be expanded. The government would then revert the 43 All-Age and Junior High Schools presently operating on double shift to single shift primary schools, utilizing the junior secondary space for additional primary age students. The remaining 28 double shift primary schools would be taken off shift strategically, by a process of rationalization and consolidation, replacement, expansion and new construction. The estimated cost for building a school to accommodate 1200 students is US$6.5 million, equipped to the standards set by the Ministry using traditional building methods. If system buildings are used, the single unit cost is projected at US$7.1 million. To achieve this goal, the government will establish a National Education Trust which will be used to fund the provision of school spaces with the cooperation and intervention of corporate Jamaica.

According to the Minister the main issues that must be addressed are

1. equity i.e. the provision of quality education for all children. This poses a challenge, as quality of education is usually related historically to class or background;
2. the education system must produce graduates that can combat overwhelming social issues of crime and poverty that beset Jamaica currently, and

[10] Shift schools have two sets of students – one shift arriving at school in the morning and leaving near noon and the other shift arriving at noon and leaving in the late evening.

3. the educational system must become world–class, capable of generating the human capital necessary for Jamaican citizens to compete in the global economy.

Chapter 2

Literature Review

Introduction

This chapter provides an understanding of research relating to building condition and how it affects the academic attainment of students in various school systems across the world. This is done through the exploration of previous research that covered topics limited to building condition and student attainment. This study was conducted at the secondary school level to answer the following questions.

- Is there a relationship between building condition and students' attainment?
- Is there a relationship between cosmetic variables and students' attainment?
- Is there a relationship between structural variables and students' attainment?

The literature review contains the most recent research in the field that are related to building condition and student attainment and the contrasting views on this topic will be discussed. Also, the Cash Model and its evolution, function and performance of buildings, specific elements relating to overall building conditions in schools, condition of facilities, critique of methodologies used in similar studies that relate building condition and student attainment are the main areas addressed in this literature review.

Associating the conditions of school buildings with students' learning is quite new. Previously, there was a lack of educational research on the topic to provide appropriate guidance or convincing evidence to direct policy decisions for school administrators, but studies in the field have increased significantly within the last four decades, as the subject becomes even more critically important to the process of educational reform and development. Studies on school building conditions began to emerge from as early as the mid twentieth century. According to

Earthman et al. (1995), "studies as early as 1967 have reported on the relationship between school building condition and student achievement and behaviour." (p. 3). Earthman et al. posited, that school authorities have two options—provide buildings that are in good condition and which maximise students' learning or provide buildings that are in poor condition and which negatively affect students learning process. There are contrasting views on whether building condition is linked to student academic score and Duyar (2010) emphasizes that "the literature fails to offer clear and convincing evidence regarding the effects of school facility conditions on teaching and learning." (p. 9). Picus, Marion, Calvo and Glenn (2005) conducted a study involving 60,000 students in the United States of America (USA) where they measured academic achievement with 3 years of standardized test scores. Analysis from the study revealed no significant relationship between scores and the quality of the school facility at any grade level. Cervantes (1999) and Guy (2001) also did not find a relationship between building condition and students' attainment. In contrast, many studies of this nature do find that building condition has significant impact on student achievement (Al-Enezi, 2002; Berner, 1993; Cash, 1993; Cervantes,1999; Crook, 2006; Earthman, Cash & Van Berkum, 1996; Edwards, 2006; Fuselier, 2008; Geier, 2007; Guy, 2001; Hines, 1996; Lair, 2003; Lanham, 1999; Leung & Fung, 2005; Lewis, 2001; O'Neill, 2000; Osborne, 2007; O'Sullivan, 2006; Schneider, 2002; Stevenson, 2001; Syverson, 2005; Vandiver, 2011).

One of the most recent scholarly works on the subject, done by Duyar (2010), confirmed that there is a positive relationship between the conditions of school facilities and the learning of students. By focusing on school facility conditions and the delivery of instruction from the perspectives of school principals in Little Rock, Arkansas, USA, Duyar showed that facility conditions are relatively more influential on teaching than poverty or other factors, and as such, require additional attention especially in terms of policy-making and allocation of resources. McGuffey and Brown (1978) concluded that obsolete and inadequate school facilities detracted from the learning process but that learning was enhanced by a modern and controlled physical environment. Earthman et al. (1996) in a study of all high schools in North Dakota, USA, rated schools as substandard or above standard for analysis. The students in facilities that were rated as substandard scored lower than those students in above standard facilities.

Although several studies have been done in this field, the methodologies and findings of research linking building condition and student attainment are disparate, and more research needs to be undertaken that speaks to the specific building elements that may be associated with student academic scores in varying parts of the world. In general, most recent research used the designations of standard, substandard and above standard for assessment of student attainment. This limits comparisons that could be made with other studies that focus on specific elements of building condition. This thesis will be the first of its kind conducted in Jamaica that specifically seeks to explore the linkages that may exist between student attainment and building condition through the comparison of specific building elements.

This literature review explores the following key areas:

- The Cash Model and its derivatives
- Functions and performance of buildings
- Specific elements relating to overall building conditions in schools
- Specific elements of building of design
- Building age
- Ventilation
- Lighting

- Temperature
- Psychological effect of noise
- Sick building syndrome
- Condition of grounds
- Condition of furniture

The methodology employed by this thesis is based on a model developed by Cash (1993) that allowed for the condition of the facility to be assessed by school principals for the purpose of comparing with students' attainment and behavior. This building condition assessment instrument was used to evaluate buildings and the resulting assessments were compared to student attainment. Cash (1993) developed a questionnaire called the Commonwealth Assessment of Physical Environment (CAPE) that included variables considered to be important based upon previous research findings that had indicated building components or conditions related to student performance (see Appendix B).

The Cash Model was used for this research because of its relevance and the adaptability of the CAPE to the Jamaican situation. The use of the CAPE is also, justified by Bailey (2009) who noted that the CAPE was successfully used in 10 out of 21 studies from 1998 through 2008. Bailey (2009) argued that using students or school personnel other than principals would lead to inadequate diagnosis of the building condition. However, as a total reliance on school principals for building assessment could introduce bias, in this thesis, in addition to a modified CAPE (MCAPE) (see Appendix C) other assessment methods were employed including site visits for verification and conversations with principals. These are further described in the methodology. See Table 4.2.

The Cash Model and its Evolution

Cash (1993) examined the relationship between the condition of school facilities and student achievement and student behaviour using the entire population of forty-seven rural high schools in Virginia, USA. Student achievement was determined by the scores of the Test of Academic Proficiency for grade eleven during the 1991-1992 school years. Cash explained that if a relationship can be found between schools' physical environment and student's outcome, then school leadership can make informed decisions which would potentially affect students' behaviour and achievement. The theoretical model is presented in Figure 2.1.

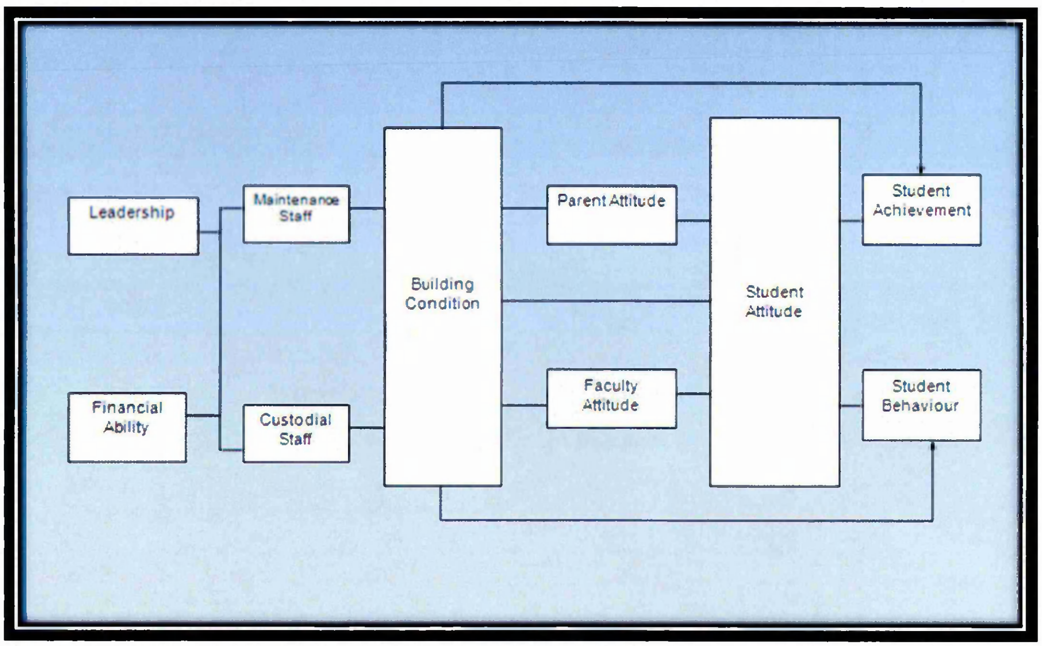

Figure 2.1. Cash's Model (1993).

Cash's theoretical model shows some possible factors that affect building condition which, in turn, affect students' academic achievement and behaviour. Specifically Cash posited that, leadership and financial ability influences building conditions through maintenance and custodial staff. Building conditions in turn influenced parent, faculty and students' attitude which in turn also influenced students' attainment and behaviour. This is therefore suggesting that facilities that are in good condition should produce students with good academic results. Cash (1993) hypothesized that better building conditions will improve student achievement. Some of her findings showed that higher achievement was associated with schools with at least some air conditioning in instructional spaces, less graffiti, better locker conditions, better science lab equipment, classroom furniture in better condition, pastel painted walls instead of white walls in instructional areas, and schools with less noisy external environment. Cash reported that the condition of facilities can account for as many as 11 percentile points on students' assessment. Building condition in this context can be considered to be very important since 11 percentile points is enough to determine if a student passes or fails a subject. In addition, it can make the difference between a pass and a distinction. Building condition is therefore very important to student's attainment and will therefore be investigated in this research.

Cash's original model has been refined by various other researchers including Lemasters (1997), Lanham (1999) and Al-Enezi (2002). Lemasters argued that building condition was further divided into cosmetic and structural condition (see Figure 2.2).

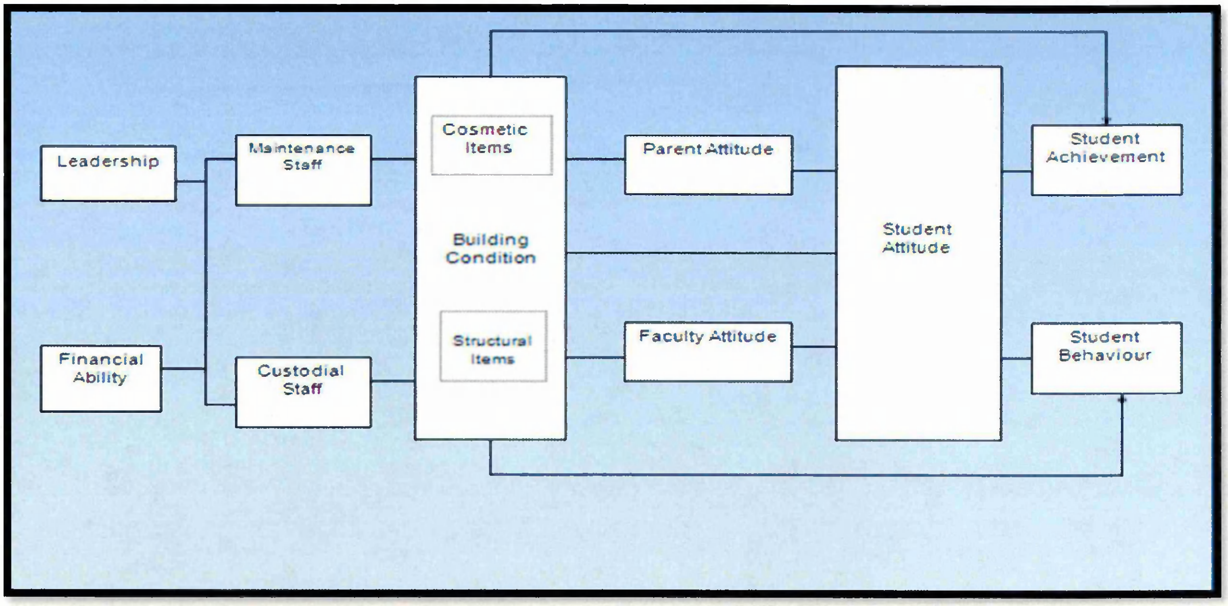

Figure 2.2. Lemaster's Model (1997).

In Stage 2 of Lanham's model shown in Figure 2.3, Lanham identified administrative decisions, funding priority, and deferred maintenance as the antecedents to building and classroom condition. He further posited that student achievement might be influenced indirectly through their own attitudes and behaviour. To use this model, three types of data are required: an assessment of the building condition, students' attainment and information on students' behaviour. In this thesis the behavioural component of the Cash Model was not investigated due to the limited and inconsistent reporting of student behaviour across the island.

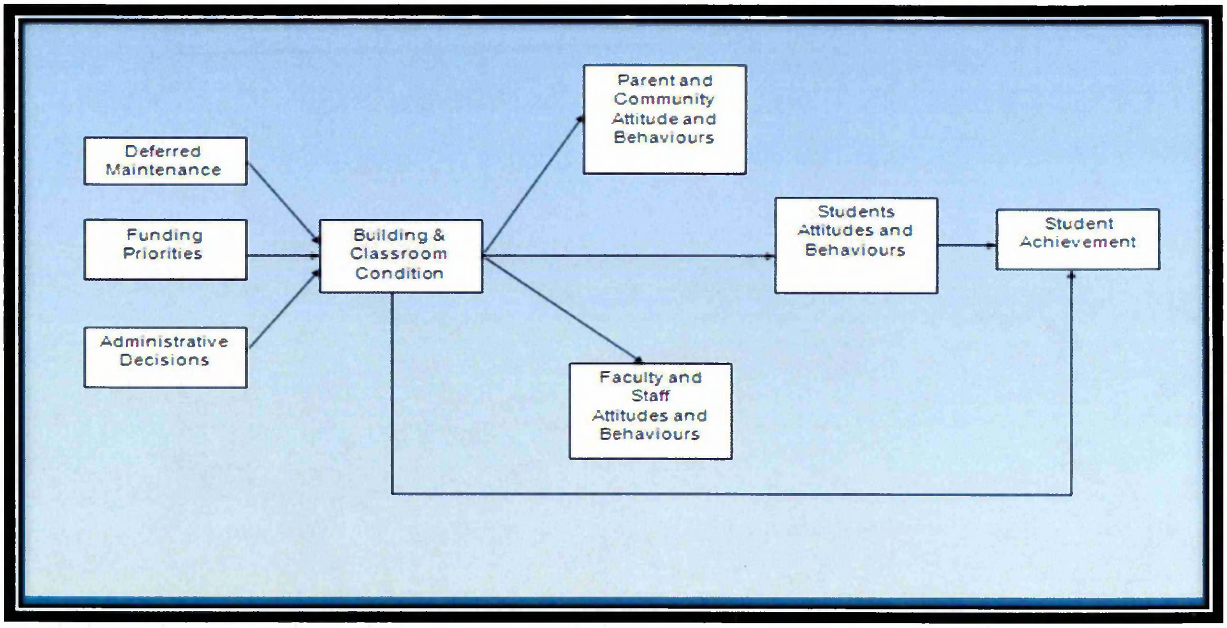

Figure 2.3. Lanham's Model (1999).

Al–Enezi (2002) synthesised three models to develop the theoretical framework for his research conducted in Kuwaiti public high schools as shown in Figure 2.4. The models were that of Cash (1993), Lemasters (1997) and Lanham (1999).

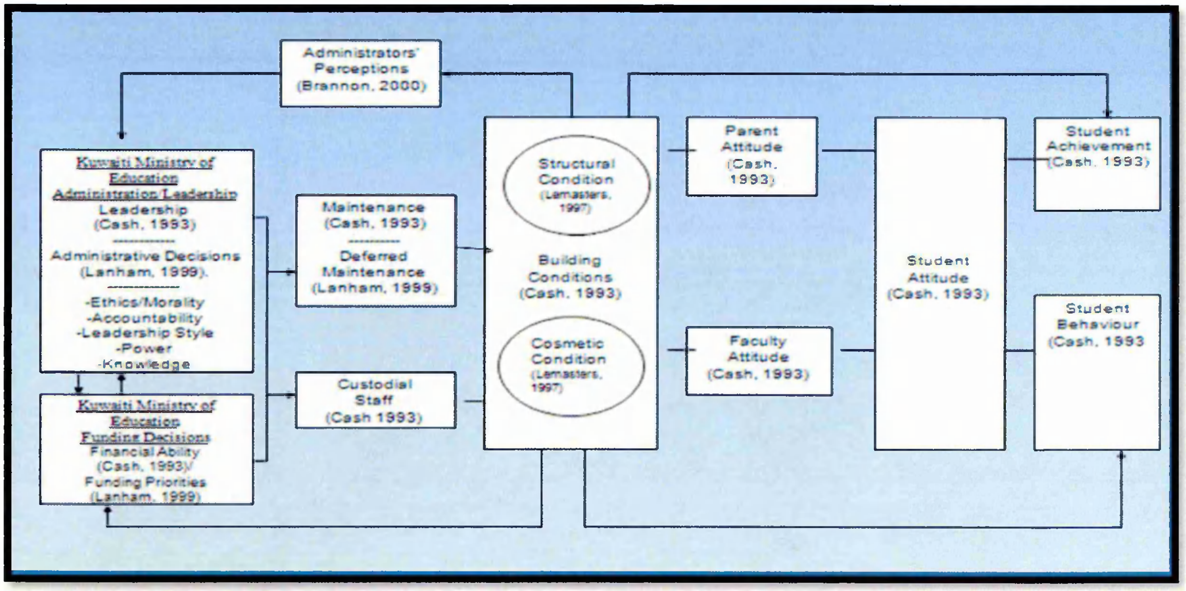

Figure 2.4. Al-Enezi's Model (2002).

Function and Performance Requirements of Buildings

Fifteenth-century humanist, Sir Henry Wooten, stated that a good building must satisfy the following conditions:

- commodity – comfortable environment conditions;
- firmness – stability and safety;
- delight – aesthetic and psychological appeal and;
- psychological appeal.

From a surveyor's point of view the function of most buildings is to protect people from weather by creating enclosed, but interconnected, spaces. The structural components of a building should assure that the elements required to fulfill its function will stand up (Salvadori, 1990). Osbourn (2002) felt that buildings should reflect contemporary attitudes towards environmental control, structural concepts and aesthetic excellence. So to Osbourn a modern building is expected to be a life support machine that provides the facilities necessary for human metabolism such as clean air and water. A modern building should also remove waste produce, control heat and humidity, provide privacy, security, and visual/acoustic comfort and be a source of energy for appliances and provide means for communication with television, telephones and postal services. In addition, a building must be safe from collapse, and from fire, storm and vermin. It must be resistant to the physical forces of snow, rain, wind and earthquakes; must be capable of adaptation to various functions, including external landscaping and internal furniture arrangements. Buildings must allow for easy maintenance, alterations and extensions as well as having a sustainable form of construction which can be adapted to changing trends and legislative requirements. All this must be accomplished in the context of providing a building which has character and aesthetic appeal (Osbourn, 2002).

There are three interrelated facets or performance requirements of a building: physical, functional and financial (Williams, 2003). Physical performance refers to a building's fabric, services and finishes, while, functional performance is a measure of the benefits that the occupier derives from the attributes of a building. "It is, in effect, a measure of a building's utility for those people that use it" (Aronoff & Kaplan, 1995, p. 26). In addition , financial performance refers to the value or worth derived from the existence or use of a building and is "likely to be measured in terms of rental income and market value" (Pinder, 2004, p. 27). Physical, functional, and financial performance are therefore important aspects of buildings that contribute to their overall performance and cannot be easily prioritised. Performance requirements cannot be placed in order of importance, because any one of the features may be more critical than another for a particular element of a building. Priority is normally dictated by the precise function and location of a specific building. In this thesis, the physical and functional performance of the Jamaican school building stock will be assessed to determine if it is associated with students' academic scores. It will be determined if particular elements of school buildings have a more significant impact on student attainment than others. Clements-Croome (1997) believed that buildings should serve people. It should not be the people who are required to adapt to the building. School buildings should therefore be designed to fulfil the needs of the students without necessitating undue and extreme adaptation on the occupants. The building should be the servant, not the master. In this respect several structural and design elements will be addressed in this research.

A building is inevitably subject to physical decline resulting from its use (Chanter & Swallow, 1996). It is the loss of the physical capacity of a building to perform the function for which it was designed that results in physical deterioration. According to Trowbridge (1964), "Left unchecked, physical deterioration will continue until the building reaches the end of its physical life—the period after which the building can no longer perform its function because physical deterioration has rendered it useless." (British Standards Institution [BSI], 2000, p. 23). This thesis investigates the effect of both age and cosmetic elements on student attainment.

Specific Elements Relating to Overall Building Condition in Schools

Building conditions in schools deals with the actual state of the facility in terms of the age of the building, window presence, window condition, classroom temperature, painting schedule, wall condition, ceiling condition, noisy complex near classroom, cleaning schedule of classroom, bathroom adequacy, bathroom condition, cleaning schedule of bathroom, presence of graffiti, condition of school ground, colour of walls, condition of furniture and the general design of these elements. The condition of a building is very important and requires detailed attention, if only in the interest of human safety as buildings are needed for all aspects of life. Each educational design principle takes as its underlying premise that all learning environment should be learner centred, developmentally and age appropriate, safe, comfortable, accessible, flexible and equitable in addition to being cost effective (Lackney, 2007). Against this background and the importance that these variables have to this research, information specific to each variable is given and the extent to which, if not appropriately designed and located, they could lead to dysfunctional buildings. The specific variables that follow are building age, ventilation, lighting, temperature, painting schedule, graffiti, ceiling, grounds and the condition of furniture.

According to Knapp et al. (2007), the design of school buildings should be done according to the building's immediate climatic, topographic, and cultural surroundings. For example, in hot regions, there should be minimal exposure to the sun, but an "effective shading mechanism" should be considered. Other variables that need to be considered are factors that are associated with the site: surface water runoff, cultural requirements like sanitary conveniences, local traditions and techniques, the attitude and skill of the population. These factors will influence maintenance and upkeep. Knapp et al. (2007) says that factors such as lighting, ventilation, heating, and maintenance friendliness should be taken into account from the early stages of planning when a building is being designed. He uses the example of school fittings and school furniture, explaining that these items are "subjected to extreme operational demands, children are very rough with the equipment they handle and this has to be adequately considered in the design stage." (p. 13).

Some of the specific elements of building design fall within two major groups: structural and cosmetic. Structural elements refer to items such as lighting, window and floor conditions, room temperature, age of building, and adequacy of bathrooms. Cosmetic elements, on the other hand, are those aspects concerning the general appearance of buildings such as painting. Cash (1993) concludes from her findings that student achievement scores were higher in schools with higher quality cosmetic building condition ratings. It is clear, therefore, that although cosmetic elements do not contribute to the functional aspects of a building, they influence the perceived purpose of the building. According to Cash (1993), in reference to school buildings, "It is a physical representation of a public message about the value of education. If students perceive education as something to be done in a poor quality facility, they may also perceive it (education) to be of less value." (p. 77). The cosmetic and structural variables in this thesis will be assessed since they give a measure of the physical representation of the school building in Jamaica.

What follows is a brief analysis of the key structural and cosmetic variables of school buildings arising from the literature reviewed. These include: age of building, window openings, ventilation and their condition, lighting, temperature, painting schedule, condition and colour of walls and ceilings, noise, classroom cleaning schedule, adequacy of bathrooms–its condition and cleaning schedule, presence of graffiti, condition of furniture and condition of grounds. According to Cash and Twiford (2010), the cumulative effect of building conditions in schools show a correlation with student achievement and there has been further research to show that a number of specific factors contribute to this phenomenon such as lighting, cleanliness of the building, health and safety, painting and students' and teachers' morale.

Building age. The term 'building age' simply refers to the age of a building, which is the number of years it has been in existence. As cited in Earthman et al. (1995), Burkhead, Fox, and Holland (1967), Guthrie, Kleindorfer, Levin and Stout (1971), McGuffey and Brown (1978) and Plumley (1978), reported findings showed that building age was significant in reading score regression. Bowers and Burkett (1987) theorized that differences will exist between the new and old schools in achievement, disciplinary actions, health and attendance.

Bailey (2009) informs that the age of a building has served as a surrogate for building condition in many research studies and that age in and itself is not a disadvantage. For Bailey, older buildings simply don't have the components newer buildings have. But other academic research explains building age to be much more—a reflection of a combination of the overall condition of the building (McGuffy & Brown, 1978), or a measure of the cumulative effects of the thermal, visual, acoustical and aesthetic environment (Cash, 1993).

In 2009 Bailey made reference to four specific studies, Stapelton (2001), Hickman (2002), Kilpatrick (2003) and Wicks (2005) that looked at school age and its impact on stake holders. The purpose of the Stapleton (2001) study was to identify perceptions of the changes that may occur between students, staff, and parents as they move or transition from an older school to a newer school. It was noted in the study that a change from an older facility to a newer facility did have an impact on the perceptions the students, staff, and parents had, but the change was a negative one. Subsequently, Hickman (2002) examined new schools in Hawaii, USA, and their relationships between school facilities and student and staff behaviour and attitude. The Hickman study found significant positive changes in staff attendance rates when moving to the new school. The purpose of Kilpatrick (2003) study was to determine whether school facility condition influenced the perception of all stakeholders of a school, which included the students, parents, and administration with regards to school climate which "is a multidimensional construct that includes physical, social, and academic dimensions" (Loukas, 2007, p. 1). The mixed method was used in this study, which found statistical significance from the security and maintenance subscale results used. That is, students had lower perceptions of safety and good maintenance at Lincoln High School, which was the older of the two high schools.

Al-Enezi (2002) stated that previous research examining the relationship between school building age and student achievement used the age of the school building as a proxy for the quality of the physical environment. In such cases, school building age was treated as an independent variable that indirectly influences student achievement with above standard building conditions being associated with higher student achievement. But the assumption that a newer building might be more efficient and have more modern technology is not necessarily valid. Further, it is not relevant to consider school building age without considering the other physical characteristics of a school that reflect the quality of the school environment. Consequently, older schools are not automatically in worse conditions than newer schools. For example, if two buildings of the same year have different maintenance programs, meaning an effective and ineffective maintenance schedule respectively, the two buildings will clearly be in a different state of repair and thus have different utility. Accordingly just looking at the building age to assess condition and state of repairs is not a good measure of building condition since an old building with a good maintenance program could be in a good state.

McGuffey and Brown (1978) investigated the influence of school building age on students' achievement in the fourth, eighth, and eleventh grades in Georgia, USA. Their findings revealed a negative relationship between the two variables. However, in the study done by Guy (2001) the researcher found that there was no significant difference between students achievement scores when comparison was made with older and new schools building. This contrasting view has been analysed and the results reported in chapter four. Guy's research was conducted in West Virginia, USA, high schools. Guy (2001) investigated the relationship between student achievement, as measured by the Total Basic Skills Test results, and the age, density, and size of the building in which the students attended school. All the high Schools in

West Virginia, USA, that had an eleventh grade and had a building principal were used in the study. This totaled 126 schools that were used in the study. The final sample of the study was 119 schools. Data included student achievement test results that were attained through Stanford Nine tests that included reading, math, language arts and science scores. The total basic skills score means were attained by calculating the mean of the four tests identified through Stanford Nine testing. Student enrollment data, grade levels served, and socio economic status were obtained through the West Virginia Education Information Center (WVEIS).

The methodology for the study identified student achievement as the dependent variable and the independent variables of building age, student density, and school size. Guy identified building conditions by ranking schools as below average, average, or above average. Data were analyzed through the Statistical Package for the Social Sciences (SPSS). Analysis of variance and covariance was performed, using socio-economic status, and student achievement data, and then compared with building condition. Guy identified a wide range of mean scores across the building condition categories. The building condition categories included a site evaluation component that assessed site condition, drainage, parking, bus loading areas, access roads, playing fields, and site utilities. The results of the analysis concluded that higher student achievement scores were not found in newer schools. Guy noted that students attending the oldest high schools scored better on Total Basic Skills Tests than students in newer schools, but not significantly higher.

From the above it is noted that there is no consensus on the matter of school age and students' attainment. This variable will therefore be investigated in the Jamaican context in this thesis. It is therefore important to determine if the age of the schools are impacting students' attainment. In most of the studies reviewed, it was found that as the building age increases, student achievement decreases. This research will determine if younger buildings are associated with higher academic performance.

Ventilation. The rate at which air exchange takes place in a building could be termed as ventilation. Ventilation in buildings should be continuous with new air taken from a clean source. A building that impedes this process can be considered defective. The most common defects in schools include insufficient outside air supply to occupied spaces, water leaks, inadequate exhaust air flows, poor air distribution or balance, and poor maintenance of heating and air conditioning (HVAC) system (Wargocki Wyon, Matysiak & Irgens, 2005). The purpose of ventilation is to ensure the quality of the indoor air without causing a feeling of cold or draught. This was traditionally achieved by opening the external envelope: windows, doors and ventilation stacks (Sebestyen, 1998). Ventilation also serves to remove or otherwise dilute contaminants that can build up inside a building. Such contaminants come from people's breathing, from their skin, clothes, perfumes, shampoos, and deodorants; from building materials, cleaning agents, pathogens, and from a host of other agents that are harmful in sufficient concentrations (Schneider, 2002). Schneider (2002) pointed to the fact that students could not function normally or learn optimally in classrooms that lack good ventilation. Clements-Croome (1997) felt that the means of ventilation (whether natural or artificial) was of less importance than the design and construction of the building serving the occupants and their requirements, being acceptable to the majority of the users and not causing adverse health effects.

Wargocki et al. (2005), conducted an experimental research titled "The Effects of Classroom Air Temperature and Outdoor Air Supply Rate on the Performance of School Work by Children" A field intervention experiment was done in two classes of 10-year-old children, where average air temperature was reduced from 23.6 degrees Celsius to 20 degrees Celsius and outdoor air supply rates were increased from 5.2 to 9.6 litres per second per person in a 2 x 2 crossover design for a period of one week. Eight different aspects of school work from Reading to Mathematics were performed during appropriate lessons and the children marked visual analogue scales each week to indicate SBS (Sick Building Syndrome)[11] symptom intensity. The research concluded that an increase in ventilation increased work rate and reduced temperature increased work rate. Wargocki et al. (2005) and Smedje and Norbäck (2000) concluded that increased ventilation rates in classrooms, compared to classrooms that had substandard ventilation rates, had more instances of better student achievement. Classrooms that had moderate temperature control and were comfortable to students produced positive effects on student performance, health and accounted for lower instances of poor behavior of students. In a study of this nature the researcher has to be aware of the Hawthorne Effect[12]. In the case of this research students were unaware that the research was being conducted, consequently the Hawthorne effect will not have an effect on the findings of this research.

If building windows are not constructed to certain sizes, specification and buildings are not oriented correctly, ventilation could be a problem, which could have adverse impact on the performance of students in the school system. It is noted that some school buildings were not

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[11] A condition marked by headaches, respiratory problems, etc. affecting office workers, attributed to factors such as poor ventilation in the work environment. - The Concise Oxford Dictionary.

[12]The Hawthorne effect is a term referring to the tendency of some people to work harder and perform better when they are participants in an experiment. Individuals may change their behavior due to the attention they are receiving from researchers rather than because of any manipulation of independent variables. Source: .http://psychology.about.com/od/hindex/g/def_hawthorn.htm January18, 2014.

constructed with the correct windows opening in Jamaica. Also, changes were made during renovation of some buildings to use concrete louvers instead of aluminium louvers thus reducing ventilation. Is this reduction in ventilation rate associated with student academic performance? It is also noted that ventilation is compromised when trying to solve noise nuisance problems. Ventilation is therefore considered to be a complex matter and needs to be investigated to determine its impact on pupils. This research will attempt to answer this question within the Jamaican context.

Lighting. "Light is energy in the form of electromagnetic radiation, which can be detected by the human sense of sight" McMullan (2002). Lighting quality is hindered or enhanced by window and door types or their absence or presence. If windows are used, that will give 100% ventilation and lighting and there will be less need for artificial lighting. There is a wealth of information on the effects of lighting in the classroom—from daylight to artificial—and research findings which bear conflicting views on which form of lighting is most suitable for the classroom (Higgins, Hall, Wall, Woolner & McCaughey, 2005). Research has also shown that controlled daylighting and appropriate lighting improve the performance and health of students and teachers (Woodside, 2008). Students cannot study unless lighting is adequate and there have been many studies reporting optimal lighting levels, as done by Mayron, Ott, Nations, and Mayron (1974), Dunn, Krimsky, Murray and Quinn (1985), Tanner and Jago (1999) and Schneider (2002). The consensus of these studies is that appropriate lighting is associated with higher test scores and plays a significant role in students' achievement. Recently, there has been renewed interest in increasing natural daylight in school buildings (Schneider, 2002).

Fisher (2001) thought generally that good lighting, both natural and artificial, can contribute to the aesthetic and psychological character of a learning space. He further stated that studies confirmed that, for fifth and sixth grade students, appropriately designed and well-maintained lighting improved students' achievement scores. Medical studies have also shown that natural light is critical to the regulation of the circadian rhythm of the body in adjusting to night and day conditions and is therefore of vital importance in instances where students spend most of the day inside classrooms. Research by Erwine and Heschong (2002) compared the results of student's performance in classrooms with and without daylight and found that children learned significantly more when there was more daylight in the room. After controlling various demographic and educational variables it was found that students in classrooms with the most daylight, improved by twenty percent in mathematics and twenty- six percent in reading compared to students in classrooms with the least daylight. The study concluded that this may have been due to better vision as a result of one or more of the following factors:

- Higher illumination levels
- Better colour rendering
- Improved spectral content of daylight
- Improved three dimensional modeling with highlights and shadows
- Reduction of flakes from electrical lighting
- Improved student and or teaching moral or performance due to:
    - Mental stimulation from varying lighting conditions
    - The calming effect of contract with the natural world (weather, time of day)
    - Greater mental alertness due to biochemical response to daylight

While the scientific foundation linking daylighting to learning is accumulating, unfortunately there have been distractions and fads that affect decisions about school lighting (Schneider, 2002). It was not until the twentieth century, that people came to realize that adequately lit living and working environments are indispensable for physical and psychological well-being. Lighting conditions are a major factor in human comfort. Lighting has grown into an important field of building research, and has acquired great importance in architectural design. The luminous environment is the interplay between a room, its natural light and the electric light. According to Flynn, Kremers, Segil & Steffy (1992) lighting is often poor in a room even though it could be improved at little cost. Lighting can be monotonous or varied and glare and odour are factors that contribute to overall satisfaction or dissatisfaction with lighting. Cash & Twiford (2010) concluded from research findings that both the presence of sunlight and the type of classroom lighting have been linked to improved students' performance.

Temperature. "A fundamental function of any building designed for human occupation is to ensure the feeling of comfort and warmth of the occupants" (Sebestyen, 1998, p. 133). Humidity is the measure of the degree of moisture in the atmosphere. The maximum proportion of water vapour in the air is about 5% by weight; yet this relatively small amount of moisture produces considerable effects. In addition, human comfort, condensation in buildings, weather conditions and water supplies are important environmental factors dependent on humidity. The amount of moisture in the air also influences the durability of materials, the drying of materials, the operation of industrial processes, and the growth of plants.

Researchers have reported a very strong relationship between thermal environment and student academic achievement. Temperatures in excess of 25°C have detrimental physiological effects which, in turn, decrease mental efficiency, work outputs and performance. In instances where temperature is above this level, coupled with poor humidification, respiration rates will increase and physical efforts become more demanding; attention spans decrease and students report more discomfort. There is also increased absenteeism and conditions favourable to disease and infection spread amongst students. According to Fisher (2001), insufficient ventilation, lack of air movement and poor humidity control are factors that can reduce the performance of students.

Polluted, humid or too dry indoor air can be deleterious to the health of the occupants, causing tiredness, headaches, nausea and even more serious illness. The causes are not always easy to identify, but indoor conditions are undoubtedly implicated and are summed up in the popular expressions "healthy buildings" (giving occupants a feeling of satisfaction with the indoor space) and "sick building" (causing discomfort to occupants). The problem has even acquired notoriety and has been labelled "sick building" syndrome. If 20% or more of a building's occupants express symptoms without a known causal agent, it is classified as a sick building (Sebestyen, 1998). A combination of various adverse factors such as indoor air temperature, draughts, moisture condensation, odour and noise can be present in sick buildings. In order to maintain a constant temperature within a building we need to restrict the rate at which heat energy is exchanged within surroundings (McMullan, 2002).

One of the earliest written works on building condition and attainment is that of Green (1974) who reviewed studies done on kindergarten children in Switzerland and students in Canadian schools in relation to temperature and humidity in classrooms. It was found that absenteeism rates were significantly higher in schools without humidifiers. Chan (1980) looked at eighth grade students in 191 public standard schools in Atlanta, Georgia, USA. Academic achievement was measured using scores on the Iowa Test of Basic skills (ITBS) from 1975-1976 and the presence or absence of 4 physical classroom variables including air conditioning. He concluded that schools with air conditioning have higher vocabulary scores that those without air conditioning.

Painting schedule, colour of wall, graffiti and ceiling. Cash & Twiford (2010) noted that the cleanliness of the school's walls was important and that the colour of the walls could impact students' attitude and academic performance. Cash (1993) noted a preference for white or pastel colours rather than dark colours in schools.

Psychological effect of noise. Lemasters (1997) informs that non–instructional noise had adverse impact on the student learner. He explained that noise causes stress: the onset of loud noise can produce effects such as fear, changes in pulse rate, respiration rate, blood pressure, metabolism, acuity of vision and skin electrical resistance. However, most of these seem to disappear rapidly and the subject returns to normal, even if the noise continues, but there is evidence to show that prolonged exposure to excessive loud noise will result in permanently elevated blood pressure. "Excessive environmental noise has been shown to accelerate mental health problems in those predisposed to mental health problems." (Hansen, 2005, p. 78). "Behavioural responses to noise are usually explained in terms of arousal theory: there is an optimum level of arousal for efficient performance; below this level behaviour is sluggish and above it, behaviour is tense and jittery. It seems reasonable to suppose, therefore, that noise improves performance when arousal is too low for the task, and impairs it when arousal is optimal or already too high." (Hansen, 2005, p. 78).

According to Lackney (2007), prolonged exposure to high intensity noise in community or work settings is often harmful to large segments of the exposed population. Lackney (2007) further explains that noise in the learning environment can originate from within as well as outside the school building and can be both short or long-term. He explained that both forms of noise can have major effects on students' behaviour, and in some cases, achievement. Noise can affect the learning process directly or indirectly. Indirectly it may cause teachers to pause during the execution of their lessons, which reduces teaching time. In addition it makes it difficult for hearing and interactions between teachers and students (Lackney, 2007).

Christie and Glickman (1980) concluded that children's performance on the standard Progressive Matrix Task increased consistently with age of the students, the research offering evidence for the notion that boys are able to solve complex matrix problems in a noisy environment. On the other hand, females tend to perform higher in a quiet rather than noisy environment. It was also found that the effect of classroom noise does not vary with age of students. Haines et al. (2001) conducted an investigation that analyzed the effects of chronic aircraft noise exposure on children's health. The study took place in the areas and schools around Heathrow airport in West London, England. Several student factors in the study involving noise included noise annoyance, indicators of stress from noise, effects of blood pressure, attention, and other stressors related to exposure to noise. The effects on student reading performance were also analyzed in the study. The study indicated that there was a significant relationship between exposure to noise and academic performance and student behavior. Noise is therefore a factor in the learning process and some schools in Jamaica are located near to noise generating facilities. This study will investigate the impact of noise on the learning process. Many schools in Jamaica are constructed in and around noise generating facilities. A noisy environment can have a devastating effect on the learning process. It is perceived that a number of noise-generating facilities are affecting the learning process: vehicular traffic, airplane, automotive train, construction activities and noise from wood and metal work shops.

Sick building syndrome. All the previously noted variables, if not regulated, can lead to sick building syndrome, which causes a higher than normal level of minor illnesses for occupants and is often of a temperate nature with most symptoms disappearing shortly after occupying the building (Brett, 1997). Brett (1997) informed that typical symptoms of sick building are irritation of the eyes, nose, throats, as well as shortage of breath, dizziness and general fatigue mainly associated with air conditioned building and those which have no control over ventilation, heating or lighting. Health is more than simply a lack of illness; it comprises various components of the interrelationship between a person and the ambient surrounding. Most people spend more than half their lives indoors, and their health is therefore greatly affected by the characteristics of closed spaces. One of the most important factors influencing human health is the feeling of comfort in relation to heat, air quality, light, and noise conditions in buildings. People have different reactions to temperature, with some preferring warmer temperature than others. Other indoor factors such as light and noise also affect the feeling of comfort or discomfort (Sebestyen, 1998). During the past 20 or so years, a good deal of building and medical research has been carried out in order to determine the effects of various conditions individually and in combination. The difficulties of such research are compounded by the fact that certain adverse factors may have only a marginal effect on health in the short-term, while their long-term impact may be very serious, especially if the effect of air pollutants is considered (Bischof et al., 1993) as cited in Sebestyen (1998). Factors such as ventilation and lighting which contribute to sick building syndrome will be addressed in this research.

Condition of Facilities

Grounds. The general atmosphere of a campus influences impressions and attitudes Peterman, (1997). For Peterman (1997), the first impressions of the grounds can affect enrolment of students, employment of faculty and staff, and the attitudes of visitors and benefactors. Peterman further explained that ground maintenance operations contend with unpredictable variables, such as living plants, pests and weather. Despite these and other challenges, the purpose of the grounds maintenance organisation is to provide a continually safe and invitingly attractive learning environment. While Peterman was addressing university campus grounds, the same considerations are also relevant at the secondary school level as it relates to grounds.

Condition of furniture. According to Beynon (1997), the useable lifecycle of durable furniture is between five and ten years. Furniture that is used for a shorter period of time is usually a result of damaged items that are not repaired. Maintenance of furniture usually involves reattachment or replacement of broken parts. Beynon (1997) noted that in many developing countries school administrations fail to put maintenance plans in place to deal with damaged furniture and he believes that furniture has a direct impact on the comfort of learners and therefore provides strong justification for the allocation of funds to maintain and repair furniture. He further posited that since educational equipment maintenance and replacement is the third most important variable related to learning, that issue should be made a priority by educational technology specialists (Beynon, 1997). This research will address how the condition of furniture impacts student attainment.

Critique of Methodologies of the Authors Presented in the Literature Review

This section contains a critical review of research that assess building condition and student performance. The major weaknesses are highlighted and the attempts that were made to correct these methodological problems are also discussed. We begin with one of the most cited studies in the field, that of Cash (1993). This critique will therefore compare and contrast the main methodological weakness identified in the field since the Cash (1993) theoretical concepts.

Further to the explanation of the Cash (1993) model in earlier part of this chapter, she utilized analysis of covariance (ANCOVA) to compare the adjusted school mean score and the ratings of school buildings. The analysis compared each of the mean achievement test scores, as well as the total composite score, across each of the three building condition ratings. In this instance, socioeconomic status (SES) was used as covariate to allow for adjustments due to SES. She completed her analysis by utilizing regression analysis to compare the mean achievement scores to the age of the school buildings included in the study. Hines (1996), whose research was similar to Cash, employed a similar methodology but utilized ANCOVA to compare adjusted mean achievement scores to the building ratings derived from the CAPE. However, he controlled SES through the use of a measure of SES as a covariate. Lanham (1999) deviated from the norm by being the first researcher to examine the structure of the CAPE instrument using principal components factor analysis. This was done to determine any common factors that exist between items included in the survey.

Lanham (1999) found thirteen factors with a value greater than one, including an age/size factor, an overall condition factor, a technology/furniture factor, a paint factor, a ceiling/lunch factor, a renovation/site size factor, a noise control/TV access factor, a windows factor, a structural factor, an electrical outlets/room structure factor, a trailer factor, a mopping/shampooing factor, and a sweeping/vacuuming factor. Lanham then completed a statistical analysis using Pearson's product moment correlation matrix and multiple regression. Lanham used an alpha coefficient of .05, as "this significance has been used throughout most studies in this field" (p. 76). The above description typifies the main analysis used in the related research mentioned in this literature review. It is also noted that the boundaries of this research field have been extended to look at gender differences as in the case of Al-Enezi (2002). This researcher (Roper) has improved on the rigor of the methodology by validating data generated from the Modified Commonwealth Assessment of Physical Environment (MCAPE) and conducting structured discussions after the data analysis was conducted. In assessing specifically the methodology of the Cash (1993) study and the four main studies--Hines, 1996; Lemasters, 1997; Lanham, 1999 and Al-Enezi, 2002--that evolved from it, is noted that all found a relationship with building condition and students' attainment. It was argued that this is expected since when school principals have a good perception of building condition, student attainment tends to be good. The assessment of school facilities by school principals is also heavily criticized and is seen as one of the avenue of bias in the research that have been conducted with a similar methodology.

Although the Cash Model has evolved and has been replicated numerous times, it is argued that it has inherent weaknesses which are listed below:

1. Research relating facility quality to student achievement is dependent on surveys of school principals' opinion of the quality of the facility.
2. The majority of the research has depended on descriptive statistics and correlations of facility quality and student test scores without controlling for the known covariates of both variables.
3. Except for a few isolated state-wide studies in the USA, the majority of the research has depended on small intact samples, or samples of convenience, hampering efforts to generalize findings to the majority of schools.
4. Independently-rated school facilities use the depreciated costs of building construction or building age to estimate the quality of the facility.

Bowers and Urick (2011) argued that much of the research on facility quality and student achievement have depended on surveys of school principal's opinions of the quality of their schools. They explained that principals are not impartial observers of their facilities, and rarely have the expertise to compare the quality of their school to others and argue that their assessments are subject to bias, thus giving impartial information. In the second instance, the majority of the research has depended on descriptive statistics and correlations of facility quality and student achievement test scores without controlling for the known covariates of both variables, such as socio-economic status of the students, as well as a lack of control for the nested effects of students within schools. This therefore means that the extent to which advanced statistical tools can be employed in data analysis in research of this nature is limited. Third, the majority of the research has depended on small intact samples, and consequent from this limitation generalization is limited. Fourth, of the studies that have independently rated school facilities, those rating either use the depreciated costs of building construction or building age to estimate the quality of the facility. The studies included in this literature review used building age.

Further to the limitations identified with Cash-like studies, Bowers and Urick (2011) found an additional limitation with one of the most contrasting studies, in terms of its findings relating to building condition and student attainment--this is the studies by Picus et al. (2005). For Bowers and Urick (2011), although this study (Picus et al.) is one of the most thorough studies in the field, it has at least five major limitations. Although the study controls for school SES, the researchers failed to account for the nested nature of achievement data.

Second, a related issue is that school-level aggregates of achievement and student-level variables are highly problematic. For example, for each of the studies of school facility condition on student achievement, the implication is that some set of school-level facility conditions influence student-level achievement. Attempting to estimate this effect without using student-level data, without controlling for student-level covariates, and by aggregating all data to the school level ignores the complex nature of the data and does not estimate the coefficients and standard errors appropriately. This has been shown in the past to lead to inappropriately assessing each parameter's significance (Hox, 2002; Raudenbush & Bryk, 2002) and to falsely rejecting or failing to reject a hypothesis. Furthermore, while the ratings used to assess building condition were independent in the Picus et al. (2005) study, the engineering checklist, much like the CAPE, aggregated both the structural as well as the maintenance conditions of the facility into a single facility condition score.

It must be noted that while Bowers and Urick (2011) attempted to address the methodological weaknesses perceived in the Cash-based and Picus studies, their research did not find any relationship between building condition and student achievement and, hence, they argued that there seemed to be an intermediating variable that needed further research. The intermediating variable is school climate. In fact, they are of the view that the body of information relating to building condition and attainment is unexplored because of the perceived weaknesses they indentified. Chapter three of this thesis explains how some of the perceived weaknesses of Cash-based models were addressed in order to facilitate this research.

Conclusion

The conclusion of this literature review is that the building condition of a school has a measurable impact on the occupants of the building. Impact in this regards speaks to hindering or aiding the occupants. The studies reviewed employed predominantly quantitative analysis but the most common thread that pulls these studies together is the fact that building condition is used as an independent variable and students' academic attainment used as a measure of academic performance. In some of the studies, student behaviour is assessed by the reports of disciplinary problems. The various studies agree to some degree that the building condition and characteristics of the building influence attainment – for the most part there is agreement. See Table 2.1 for a summary of studies that look at building condition and student attainment.

Table 2:1

Summary of Literature Review On Building Condition

Author	Investigation	Population	Methodology	Findings
Cervantes (1999)	Investigated the condition of school facilities as it relates to student achievement and behavior.	19 Alabama schools	Quantitative analysis	• Relationship between educational environment and reading achievement. • Significant relationship between overall building and suspension rate.
Lanham (1999)	Investigated the relationship between student achievement and the physical condition of school buildings, using the Cash Methodology.	299 elementary schools in Virginia	Quantitative analysis	• Air-conditioning was significant when mathematics and English were compared. • Theorized that improving temperature in classroom had direct effect on academic improvement in performance of mathematics and technology; consequently she concluded that the physical environment was a significant factor in student achievement. • Sweeping and classroom structure were predictor variables that were significant when accounting for student achievement.
O'Neill (2000)	Investigated school facilities and their relationship to student, behavior, attendance and teacher turnover rate at selected Texas middle schools in Region 13.	76 middle schools were included in the sample from 48 school districts	Quantitative analysis	• Found that there was significant difference between student achievement scores when comparison was made with old and new school buildings. • Theorized that academic learning space of students was also a predictor of students' achievement in mathematics and reading.

Guy (2001)	Examined the relationship between school condition and student achievement in West Virginia high Schools.	119 schools	Quantitative analysis	• Higher student achievement scores were not necessarily found in newer school buildings. • He agrees that there was a relationship between school facilities student achievement. • He reported that none were statistically significant.
Lewis (2001)	Investigated the relationship of facility conditions and student test performance in the Milwaukee public school system	139 K-12 public school s in the Milwaukee School District	Quantitative analysis	• Student achievement was related to overall building condition.
Stevenson (2001)	The relationship of school facilities condition to selected student academic achievement outcomes.	The population for the study included 988 school buildings of which approximatel y 534 were elementary schools	Quantitative analysis	• Overcrowding, poor physical condition of the school plant, portable classrooms, lack of storage, and inadequate laboratory space were all variables that adversely impacted the education process.

Al- Enezi (2002)	Investigated the possible relationship between the conditions of high school buildings and student and achievement in Kuwait.	56 high school s	Quantitative analysis	• Concluded that graffiti and roof leaks were two main predictors of environments that affected student achievement in school. • A significant relationship exists between structural and cosmetic building condition.
Lair (2003)	Investigated the effect of school conditions in Texas and the effects they may have on students' achievement.	29 schools in Texas	Quantitative analysis	• Building age and maintenance account for a large amount of student performance variance when accounting for student achievement in Texas. • Reported that there was a relationship between overall building condition and student achievement.
Leung & Fung (2005)	Analyzed the relationships between facility management and the effect that facilities management had on learning behaviors.	750 primary schools in China	Quantitative analysis	• Found a relationship between student achievement scores when overall building condition was the independent variable, but none of the relationships were significant.
Picus et al. (2005)	Investigated the relationship between student achievement and the quality of education.	60,000 students from across the state	Mixed method including quantitative analysis	• Found that there was no relationship or significance between building conditions and student attainment.
Syverson (2005)	Investigated the relationship between building condition and students' scores.	50 Schools	Quantitative analysis	• Reported a significant relationship between the overall building condition of schools in Indiana with student achievement.

O'Sullivan (2006)	Investigated the possible relationship between schools building conditions and student achievement in high schools	250 randomly selected high schools were used for the study	Quantitative analysis	School facility in Pennsylvania adjacent to the school, such as swimming pool, and the location of graffiti were the predictors of overall building condition that affected student achievement considering mathematics performance.
Edwards (2006)	Investigation analyzing school facilities and student achievement.	14 middle school and 25 high schools were used	Quantitative analysis	• Found that space considerations have a significant relationship where students chose to interact, especially classroom.
Bullock (2007)	Investigated the relationship between school building condition and student achievement.	111 schools participated	Quantitative analysis	• Reported a positive relationship between middle school in Virginia and student achievement and the student performance in newer or recently renovated schools.
Crook (2006)	Researched the relationship between the percentage of students passing the Standard of Learning Examination and the condition of educational facility in high schools.	142 high schools	Quantitative analysis	• Building condition had significant relationship with student achievement.

Geier (2007)	Investigated the facility quality of elementary schools and the influence on student achievement.	90 elementary schools	Quantitative analysis	• Overall building condition did not have an effect on student achievement, but the variance was low. • Thermal comfort was identified as a significant predictor in determining math performance on the Pennsylvania system of school assessment.
Osborne (2007)	Explored the relationship between teacher perception of suitability of elementary schools and student scores.	40 elementary schools	Quantitative analysis	• Significant relationship was identified between the educational level and thermal comfort of teachers. • Significant relationship was identified was shown between the educational level of the teacher and their privacy in school.
Fuselier (2008)	Studied the relationship between the selected school building facility component and student achievement .	145,000 eight grade students	Quantitative analysis	• Fuselier concluded that building conditions of lighting, thermal conditions, and acoustics had a correlation with student achievement, although they were deemed minimal.

It must be noted that most of the research variables that are included in building-related studies that are compared with student attainment evolve from research findings, meaning that most variables that are included in earlier building survey instruments stem from other studies that found these variables to be statistically significant. This is especially so for those studies that used the Cash Model and which modified it to suit their situation.

According to the literature review, academic learning space, graffiti, roof leaks, and thermal comfort were good predictors of students' performance on specific subjects. It also appears that when overall building condition is used as a variable, less significance is found with students' attainment than when individual variables are used. Overall the findings of the research are suggesting that better facilities are associated with higher attainment scores. It is of significance to note that the two studies using the Cash Model that were conducted out of the United States reported that a relation was found between building condition and students' attainment. Al–Enezi (2002) from Kuwait concludes that graffiti, and roof leaks were two main predictors of the environment that affect students achievement in school and informs that a significant relationship exist between structural and cosmetic building condition. In Hong Kong, Leung and Fung (2005) found a relationship between students' achievement scores when overall building condition was the independent variable, but none of the relationship was significant. One of the objectives of this study is to determine if such a relationship exists in the Jamaican context and if the relationship is significant.

Few studies exploring building condition and student attainment were conducted outside of the United States of America - one in Kuwait and the other in Hong Kong. This thesis will be the third study to be conducted outside of the United States and the second to use the Cash Model outside of the United States; Al-Enezi (2002) was the first. Also of significance, this study will be the only one done in a developing country with a low GDP, thus further contributing to its uniqueness. The assumption is that a less developed economy has less money to spend on school facilities thus result in substandard building conditions and decisions made on the basis of availability of funds. A better understanding of the effect of building condition on the student attainment is critical to the allocation of scarce funding and the overall success of schools in Jamaica. Another unique aspect of this research will be the fact that building condition will be assessed under a totally new condition--the Jamaican context.

The literature review revealed no known studies conducted in the Jamaican context relating to building condition and student attainment, and this therefore justifies the need for this study. Moreover these studies stressed the need for research to be conducted in this area in other countries. It is expected that the findings from the completion of this research will guide school administrators in the formulations of strategies to solve the existing problem of poor performance in schools in Jamaica. In light of methodological weakness identified in previous studies this study proposes a more rigorous procedure. In addition, structured discussions with school administrators formed part of the research procedure. The full methodology is described in the chapter that follows. In summary, the literature review gave an account of the Cash Model's development and its evolution in other countries and the functional and performance requirement of buildings as it relates to possible factors that could affect the building condition. The specific elements relating to the overall condition of facilities were also discussed showing the importance of such elements as it relates to building condition. The literature review ended with a critique of the studies using the Cash Model and those that opposed its findings.

Chapter 3

Research Method

Introduction

The preceding chapter gave a critical review of research into building condition and student academic attainment. Little or no research has been undertaken in Jamaica on this topic; consequently, my aim was to make a contribution to this field in the form of a quantitative study of building condition and student attainment in Jamaica. Another reason for this research was that financial support is lacking for the maintenance of school buildings and the design and erection of new infrastructure, and as a consequence some of the buildings are in a bad condition. If it can be determined which of the independent variables have the greatest impact then maintenance needs can be prioritized, thus enabling the use of scarce funding on targeted areas to give the highest impact. Based on the literature review, building factors that are associated with student attainment will include the age of the building as well as cosmetic or structural condition of the building. The objective of this study was to examine the association of certain building features and their condition as it relates to students' attainment. These include, building age, cosmetic and structural features. The following hypotheses were tested:

- H_1 = There is no difference in student attainment between new schools, average aged schools, and old schools;
- H_2= There is no difference in student attainment between schools with differences in cosmetic conditions;
- H_3 = There is no difference in student attainment between schools with differences in structural design.

The hypotheses tested yielded results that will determine where scarce financial resources are to be allocated and provide arguments for the support of improved financial resources to support good facility conditions. Figure 3.1 gives the structure of this chapter.

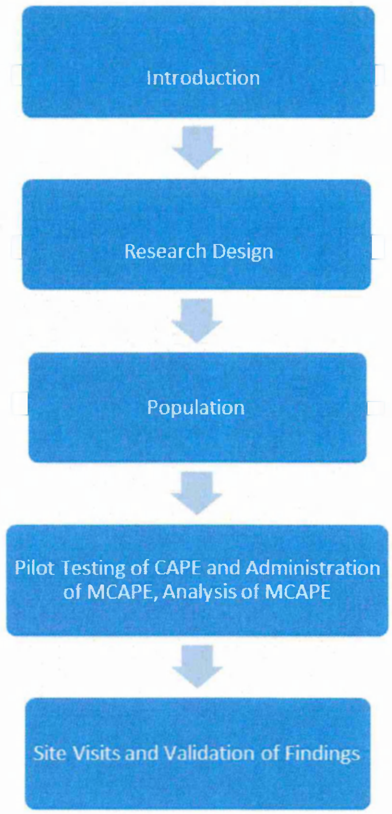

Figure 3:1. Structure of Chapter 3.

Research Design

The research design that was chosen for this thesis was non-experimental and allowed the researcher to investigate variation, or relationships in existing groups rather than actively making changes that might alter the degree to which things vary (Bastic & Matalon, 2004). That is, no adjustment was made to the independent variables and they were analysed in their existing state, as opposed to experimental research where changes are made to the variables to determine outcome. The two variables that were tested were building condition and student attainment. A deductive research method was used for this research since it facilitated the use of Cash's (1993) theoretical model which was explained in detail in chapter two. The deductive research method includes descriptive and rational research using correlation and causal/comparative methods using surveys and questionnaires (Bastic & Matalon, 2004). In this research Cash's research method was replicated within the Jamaican context.

Population

The Jamaican education system consists of a four-tier system: early childhood, primary level, secondary level and tertiary level. Educational institutions up to secondary level are divided into six regions namely

- Region 1: Kingston, St. Andrew and Western St. Thomas
- Region 2: Eastern St. Thomas, Portland, and St. Mary
- Region 3: St. Ann and Trelawny
- Region 4: St. James, Hanover, Westmoreland
- Region 5: St. Elizabeth and Manchester
- Region 6: Clarendon and St. Catherine

The age of each student determines the level of the education system in which the student is placed. The population for this research was all public secondary schools. There were approximately 164 public secondary schools in Jamaica and there were five types of institutions offering secondary education: All-Age, Primary & Junior High, Secondary High, Technical High and Vocational/Agricultural. For the purposes of this thesis, only public secondary high schools were included in the population. The decision not to use the latter two categories was based on the fact that these schools have a vastly different curriculum and some students attending these schools enter at older ages. That is, some students entering the Technical High could enter from an All-Age school that goes up to grade nine. The bulk of the students entering Secondary High Schools enter from Primary Schools that go up to grade six. Table 3.1 gives the type of schools, by numbers and enrolment. All private schools were eliminated from the population for it was difficult to obtain access to the academic attainment of students at these schools.

Table 3.1

Enrolment within the Education System at the Secondary Level

School type	Quantity	Enrolment	Percentage
All –Age (Grades 7-9)	348	12,399	5.0
Primary & Junior High (Grades 7-9)	89	22,888	9.0
Secondary High	139	178,212	73.0
Technical High	14	17,434	7.0
Vocational /Agriculture	2	376	0.2
Sub-total	592	231,309	94.2
Private Secondary		13,875	6.0
Total		245,124	100.0

Note: Adapted from the report of the Jamaican Task Force on Education Reform (TFoER). Due to "rounding off" the total % does not add up to 100%.

A pilot test was conducted with ten schools that were randomly chosen (See Appendix D for relevant letter from University of Sheffield Hallam and Appendices E and F for letters regarding pilot testing). These schools were also a part of the population for the actual research which resulted in maximizing the sample size.

Data Needed for this Study

The data needed for this study was information regarding student achievement for each school, the socio-economic status of the students attending each school and the condition of school facilities. Cash's (1993) theoretical model was used in this thesis; Figure 2.1 illustrates the Cash Model. Cash's (1993) Commonwealth Assessment of Physical Environment (CAPE) was modified in the manner outlined in Table 3.2 to suit Jamaican conditions. Site visits were also undertaken at three stages of the research process: during the pilot testing, during administration of the MCAPE and during follow-up visits after data analysis. Building condition was determined by analysis of data obtained through the use of the Modified Commonwealth Assessment of Physical Environment (MCAPE) and the survey and inspection of over 50% of the school facilities which occurred during pilot testing site, during administration of the MCAPE and after data analysis (see Appendices G and H).

The CAPE has been successfully used by other researchers namely Cash (1993), Hines (1996), Lanham (1999), Al-Enezi (2002), Crook (2006) and Bullock (2007) to determine the school building condition according to the perception of the school principal. Thus the building condition ratings were calculated from the responses provided by the principals on the Modified Commonwealth Assessment of Physical Environment (MCAPE). The average attainment of students from each school was used to determine the overall performance of that institution. Of the possible 24 subjects that each school taught, six subjects and the corresponding student attainment were chosen for this research. The six subjects were chosen because they were the most common subjects taken by the students of the schools that participated in the research. Examination results of grade 11 students who sat the Caribbean Secondary Examination

Certificate (CSEC) in the 2008-2009 school year were used to examine the relationship between school building condition and student achievement at the secondary school level.

The questionnaire was sent to all of approximately 164 secondary school principals in the population with the permission of the Chief Education Officer in the Ministry of Education. After the return of the MCAPE instruments, the researcher reviewed each questionnaire to ensure that they were completed accurately. The review carried out was to ensure that only one tick was made for the various responses for each question. Once the review was completed and the instruments were found to be properly completed the information was entered into Statistical Package for the Social Sciences (SPSS) for analysis.

Table 3.2

Modifications made to the CAPE

Item	Original variables	Modified variables	Comments
		School name added.	Added to identify schools.
1	Age of facilities	School type added.	Categories expanded to include older schools present in the Jamaican education system.
2	Presence of windows	This question was not altered.	
3	Type of flooring	Change to question took account of the condition of floor rather that the type.	
4	Heating quality	This question was removed.	Tropical countries like Jamaica do not require heating.
5	Quality of air-conditioning	This question was removed.	Jamaican schools scarcely have air conditioning systems in classrooms, except for computer laboratories. The availability of labs was not assessed in this research, because it was not related to building condition.
6 -12	Painting of interior wall	Remained the same.	
13	Frequency of mopping of instructional area floors	This question was removed.	Question 12 measured schedule.
14	Presence of graffiti	This question remained the same.	

15	Duration of graffiti	This question was removed.	Painting frequency addressed this question, which was not altered.
16	Locker condition	This question was removed.	Lockers are not usually found in Jamaican schools.
17	Interior ceiling materials	This question was altered to take account of the condition of the ceiling.	Information required was the condition of the ceiling.
18-19	Availability of utilities	These questions were removed.	
20-23	Lighting, classroom furniture, grounds, and colour of walls	These questions remained the same.	
25-27	Condition of facilities, square area and acreage	These questions were removed as it was felt that they didn't garner information on the condition of school facility.	

For the purposes of this research, the percentage of students passing the Caribbean Secondary Education Certificate Examination (CSEC) for the 2008-2009 school year for each school was used to represent student achievement. Specifically, the CSEC results[13] for eleventh grade students for the English Language, Mathematics, Principles of Accounts (POA), Principle of Business (POB), Social Studies and Visual Arts subjects were used in this study. The steps undertaken to conduct the research for this study are graphically represented in Figure 3.2. and further described in the following sections.

Determination of Percentage Passes of Schools

Table 3.3 below shows how the percentage pass for each of the six subjects were calculated.

Table 3.3

Calculation of Academic Scores for Schools for a Typical Subject

Possible Passes	Grades	Number of Students	Pass / Fail
Pass with grade 1	1	4	Pass
Pass with grade 2	11	14	Pass
Pass with grade 3	111	4	Pass
Pass with grade 4	1V	2	Fail
Pass with grade 5	V	4	Fail
Pass with grade 6	V1		Fail
Pass with grade UNG	UNG		Fail
Total sitting		28	
Total Passing		22	

Note. *UNG means "ungraded" which is a failing grade.

[13]CSEC results were compiled by the Planning and Development Division's Policy Analysis and Research Unit of the Ministry of Education (MOE) in October 2009 and published in "Performance of the COP schools in the 2009 CSEC Examinations".

Table 3.3 shows the seven possible grades that a school A received in the 2009 Caribbean Secondary Education Certificate (CSEC) examinations. This information was collated by the Planning and Development Division's Policy Analysis and Research Unit in the Ministry of Education in October 2009. Table 3.3 shows that a total of 28 students took the subject and 22 students passed thus giving a percentage pass of 78.6% (22/28 * 100 = 78.6%). This methodology was used to determine the grades for all schools in the six subjects that were used in this thesis.

Research Methodology

Figure 3.2 gives a diagrammatic representation of the research methodology of this research. The Commonwealth Assessment of Physical Environment (CAPE) was pilot tested in ten high schools which consisted of administering the CAPE in its original form. Based on the responses to the ten pilot tested questionnaires, the researcher's own observations and structured conversations with some of the principals, the CAPE was modified to create an instrument that better suited the assessment of school facilities in the Jamaican context. This instrument was called the Modified Commonwealth Assessment of Physical Environment (MCAPE). The MCAPE was then administered in 164 schools by mailing questionnaires to principals. Afterwards, follow-up by way of phone calls and email to principals was done. The 84 returned questionnaires were checked for accuracy, which revealed that one of the questionnaires was not accurately filled out, thus reducing the sample to 83. These questionnaires were then coded as shown in Appendices I and J and were then analyzed using four statistical tools. Based on the findings of the analysis, follow-up visits were made to some of the schools to explore unexpected findings. The academic scores for the six subjects were determined by using information received from the Ministry of Education. The previous section outlined the methodology employed in determining the percentage passes for each subject at particular schools. The findings were then presented and conclusions for the research were drawn.

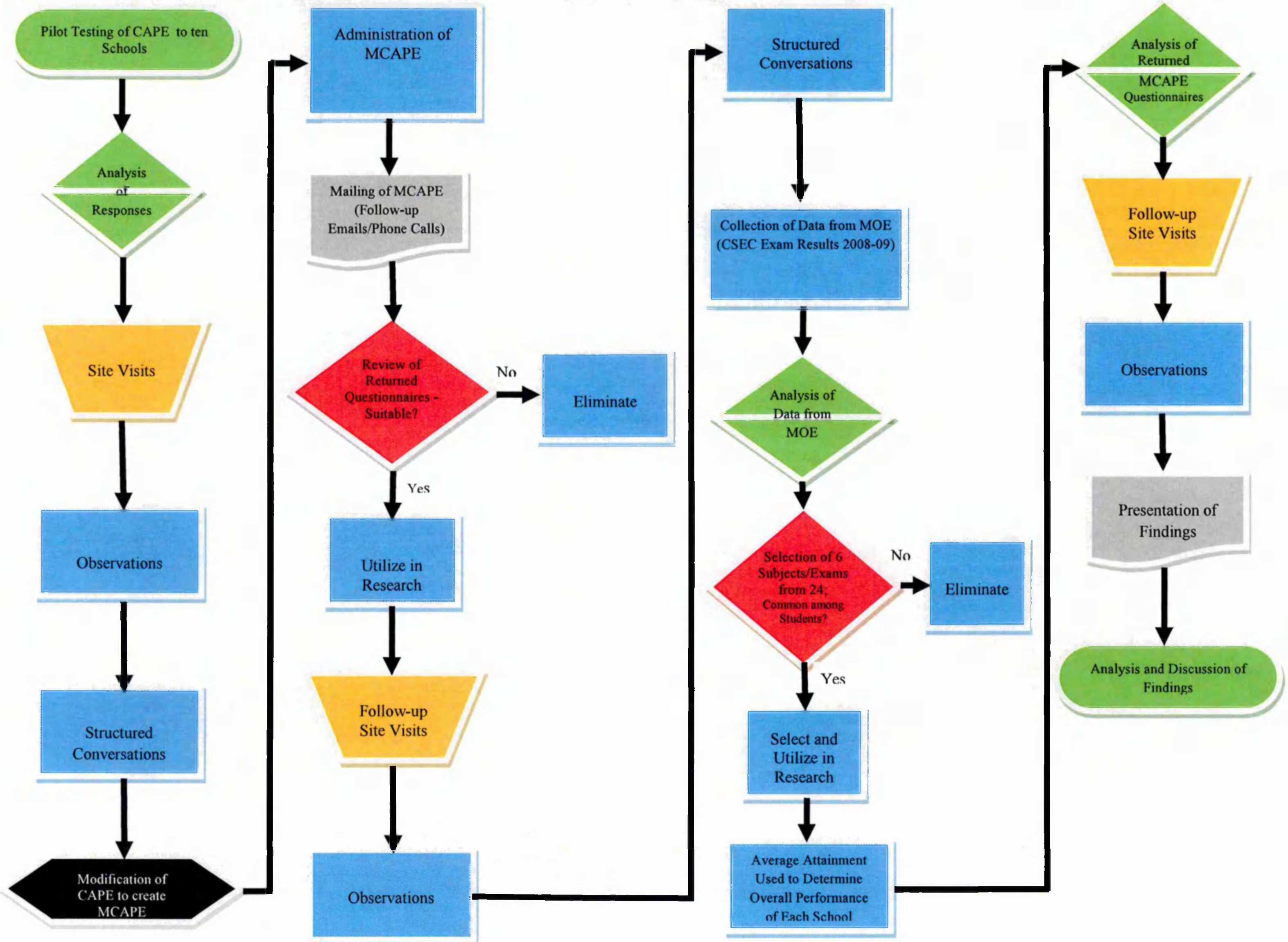

Figure 3.2. Diagram of Research Methodology.

Pilot Testing of CAPE and Administration of MCAPE

Prior to the administration of the MCAPE, a letter was written to the Chief Education Officer of the Ministry of Education introducing the researcher and informing him of the research and requesting assistance by way of allowing the following:

- the research to be conducted in the Jamaican education system;
- pilot testing of the questionnaire in ten high schools;
- the administration of the questionnaire after the pilot testing;
- access to students' academic results for academic year 2008/2009.

A pilot test was conducted on March 15, 2009. Ten schools were randomly selected from the school population to which the CAPE was sent with the permission of the Ministry of Education and all ten questionnaires were returned (see Appendix G). Based on the responses and personal visits made to the schools it was determined that some of the questions needed adjustment. Questions from the CAPE requested information, for example, on type of floor rather than the condition of the floor. In Jamaica a floor could be considered concrete, yet in good condition. Table 3.2 shows the questions and the modifications that were made to improve the response rate. The questionnaires were then re-administered between April 17, 2010 and August 31, 2010. On April 11, 2010 the MCAPE was mailed to the entire population (164) with a cover letter introducing the researcher and with a self-addressed and stamped envelope enclosed (see Appendix H). Each principal was given three weeks to fill out and return the questionnaire. Follow up emails and telephone calls were made to principals to remind them to complete and return the questionnaires.

Analysis of the MCAPE

The results from the MCAPE instrument facilitated the categorization of the schools, according to building condition. This assessment was used to compare student performance across various types of school conditions. The 84 questionnaires returned were critically analyzed for completeness and conformity. Of the total 84 received, only one was deemed unsatisfactory to be used in the research because some questions had multiple answers. After the receipt of the completed survey instruments the first question was collated and represented using descriptive statistics. The remaining data generated from the questionnaires were then coded and entered in Statistical Package for the Social Sciences (SPSS) for interpretation. The hypotheses were examined at 0.05 level for the various statistical tests to determine significance. The following analyses were "run". Below is a summary of the various analyses that were conducted. (These are explained in more detail in Appendix K).

- Descriptive Statistics
- Spearman's rho
- Kruskal-Wallis
- Mann-Whitney U test
- Multivariate analysis of variances (MANOVA)

Chapter four presents data gathered from completed questionnaires and personal visits to schools, observations, and discussions and the corresponding descriptive statistics. Variables were also checked for any violation of the assumptions underlying the statistical techniques that were used to address the research questions (Pallant, 2007). Bastic & Matalon (2004) stated that employing the technique of descriptive statistics will describe or characterize the obtained data and give a summary of certain aspects of the results so they can easily be understood by the reader. Keller (2005) also posited that descriptive statistics deals with methods of organizing, summarizing, and presenting data in a convenient and informative way, using graphical techniques which allow statistics practitioners to present data in ways that make it easy for the reader to extract useful information.

The descriptive statistics that were run are presented in chapter four and was done for all of the independent variables. The purposed of running descriptive statistics was to pull together information relating to the school stock itself. It was felt that a thorough understanding of the school stock would aid in the interpretation of all the other statistical tools that were used in this research.

Analyses were generated from two sets of data, the first from all the questionnaires (83) collapsed to reflect good and very good building condition as one combined category as well as bad and very bad as another combined category. The second set of data was from a reduced sample of 57 which was created by removing all the very young schools and the very old schools in order to determine if there were any intervening factors that were impacting these schools but were not impacting the middle-aged schools. Responses to this reduced sample of 57 were also collapsed; excellent and good were grouped, and so were bad and terrible. From the creation of the second group, independent variables were investigated using the appropriate statistical tools. Basically, independent variables were used to gather information on the conditions of buildings. The mean ranks for these categories were compared to determine if there were any statistical differences between or among the variables.

Spearman's rho, Kruskal-Wallis, Mann-Witney U test and multivariate analysis of variances are presented in Chapter 5. All the analyses were done using the two sample sizes of 83 and 57. Also, all the statistical tools used in this research were non-parametric statistical tests, that is to say, those designed to be used when the data are not normally distributed. Table 5.1 in chapter five shows the shapes of the histograms generated from the dependent variables. None of them are symmetrical in shape, thus justifying the used of non-parametric tests for this study.

Spearman's rho is a statistical test that shows the *strength* and *direction* of relationship between two continuous variables that are arranged in rank order (Pallant, 2001). Spearman's rho was only used to analyse school age since school age was the only continuous independent variable on the questionnaire. The findings of age of school facilities and the six academic subjects after running Spearman's rho revealed that the independent variable Age (school building age) was statistically significant with all six subjects, five at $p < .01$ and one at $p < .05$. To be sure that there was nothing very special about schools that were newer and those schools that were very old, these two categories of schools were removed from the original sample and recoded, thus leaving schools that were of average age, i.e. between 21- 60 years old. This amounted to 57 schools of the 83; that is 69 % of the schools that responded. This group was called average-age schools. The decision to remove the young and very old schools was made when the researcher realized that when Spearman's Rho was used, there was constant and significant correlation found with age. The average age of 57 schools was divided into two groups ranging from 21- 40 years (33) and labelled younger schools, and those from 41 – 60 years labelled old schools (24).

Site Visits and Validation of Findings

Site visits were undertaken at three stages of the research process: during the pilot testing, during administration of the MCAPE and during follow-up visits after data analysis. After the analyses were run with SPSS, site visits were made to 31 schools to observe the differences between schools that were performing exceptionally well and poorly. The visits provided an opportunity to professionally validate the reports from principals, and to “get behind the data” in the sense of a better understanding of conditions on the ground. In order to contextualise the findings of the various analyses and site visits, discussions were then held with principals and Ministry of Education (MOE) officials such as the Chief Architect, Chief Building Officer and Building Officers. The data analyses and observations from site visits are given in chapters four and five.

Chapter 4

Research Findings - Univariate Analysis

Introduction

The purpose of this chapter is to present the findings of some of the MCAPE survey results; that is, to present the univariate analysis conducted on the condition of the built environment of secondary schools: the age, the adequacy of windows and their condition, the adequacy of the lighting, the temperature of the classrooms, the painting schedules of wall and ceilings, the proximity of noise generating facilities to classrooms, the adequacy of bathroom facilities and their cleaning schedules, the presence of graffiti, the condition of classroom furniture and grounds, and the colour of the facilities, and associating these variables with academic scores.

After pilot testing the CAPE and administering the MCAPE (which was used to conduct this investigation) site visits were made to 35 schools to validate the results from the returned questionnaires. The assessment of the principals and the researcher's own site visits is captured in Tables 4.20 and 4.21.

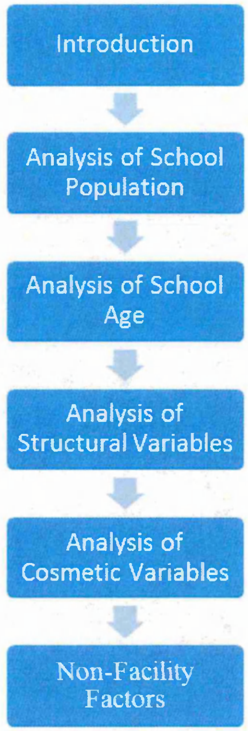

Figure 4.1. Structure of Chapter 4.

Analysis of School Population

The specific characteristics of the school population being analysed are school type male, female, co-ed, shift or boarding schools (where living accommodations are provided for students). The sample comprised 83 schools from six regions. The highest number of schools which responded to the MCAPE questionnaires from any region was 27 schools located in Region 1, comprising a little less than a third of the sample, and this was followed by Region 6, comprising 24 schools, and the lowest number five, from Region 5, representing 6% of the sample. Three regions, two, four and five, were combined, comprising approximately one -third of the population which represented 32.5% of the sample. A profile of the sample of schools is presented in Figure 4.2.

Figure 4.2. Schools by Region that Participated in the Survey.

The first question of the MCAPE questionnaire asked that principals give the name of the school from which they are reporting, just for the purpose of identifying the school in the population. The second question on the survey asked principals to identify their school type. The findings are presented in Table 4.1.

Table 4.1

Frequency (F) and Relative Frequency (RF) Distribution for School Types A and B

School Type A	F		RF%
Male	6		7.2
Female	10		12.0
Co-ed	67		80.7
School Type B	**F**		**RF%**
Boarding	2		2.4
Shift	18		21.7
Non–shift	63		75.9

Analysis of School Age

Site visits revealed that building stocks varied considerably as the built environment bearing the newer classrooms was constructed at various stages of the schools' life, some commencing with the conversion of church facilities into classrooms. These buildings were divided into three distinct groups: original buildings, permanent additions and temporary buildings. The original buildings of older schools were usually a church or religious group's facility that was used as a school facility. These buildings usually became permanent parts of the school building stock and formed central points of the schools with some distinct architectural features. Permanent additions and construction were those buildings constructed under the supervision of the Ministry of Education and were predominantly structurally sound except for the latest set of bungalow buildings, which were poorly designed and constructed. A distinctive feature of these buildings was walls constructed with zinc sheets as external cladding which were without insulation and which were unbearably hot inside the building.

In response to increasing number of students in the population, temporary buildings are being erected by the principals and sometimes by the Ministry of Education to cater to a space deficiency in schools. They are usually bungalow type buildings constructed with concrete bases and timber frames, clad with form ply or aluminium sheeting and with roofing constructed of low quality sheeting. A recent bungalow design being implemented by the Ministry of Education and now being widely utilised, consists of timber buildings clad on the outside with aluminium sheeting with hip roof[14] construction, covered with aluminium sheeting (see Figure 4.3). This particular building type is poorly ventilated with low internal timber partitions and presents a safety hazard to students, staff and visitors due to poor construction. Aluminium sheeting has sharp edges which, if not properly covered due to shoddy workmanship or are exposed by vandals, can cause serious injuries.

The varying building ages have added to expansion and renovation problems because of the variability of maintenance needs. The lack of standardization in design increases maintenance costs as there are different building types within a single compound and across the system which require different materials and construction expertise. Very old building types are costly to repair because the specialised skills required have become scarce and therefore more costly.

[14] A hip roof is a type of roof where all sides slope downwards to the wall, usually with a fairly gentle slope.

Figure 4.3. Elevation of Aluminium-Clad Building.

The majority of school buildings in the sample were constructed 21 to 40 years ago. Others were built between 41 and 60 years ago. Only seven of the schools were less than 20 years old and 17 of the schools were constructed between 61 and 120 years ago. Only one school did not report its age and two of the schools were constructed in the 19th century. In 1966 a sweeping plan for education reform titled "New Deal for Education in Independent Jamaica" was introduced (Seaga, 2010). Under this program the World Bank financed the construction of 50 new secondary schools to augment the existing 47 schools at the secondary level (Seaga, 2010). These schools would now be approximately 40 years old, thus reflecting consistency with the responses from the questionnaire which indicated that approximately 40% of the school building stock was between the ages of 21 and 40 years.

Analysis of Structural Variables

Availability of windows. There are many types and sizes of windows, the choice of which affect not only the appearance of a building, but also the natural lighting, ventilation, view potential and spatial quality of the building's interior (Ching, 1991). Ching (1991) explained that like exterior doors, windows should provide a weather-tight seal when closed, having insulation value, and should resist the formation of condensation on their interior surfaces. The windows commonly used in the Jamaican education system are manufactured from aluminium, wood, or concrete and are usually done in various combinations as shown in Figure 4.4. They range from fixed, casement, to jalousie windows, which give ventilation of 0% to100%.

Figure 4.4. Combination of Window Styles on School Building.

Aluminium jalousie windows are mostly used in the education system because of their reasonable cost when compared to other window types. In addition, the 100% ventilation potential, speed of installation and their availability have made aluminium jalousie windows one of the most common window types. Other advantages of aluminium jalousie windows are that they can be installed over a wide span, they are fairly attractive, provide good shading from the sun, and have high resistance to hurricane winds. However, they are unsuitable for use in spaces that need to be air-conditioned because of the large gap at various sections of these windows , thus making the cooling of air within those spaces expensive.

The use of aluminium jalousie windows is being restricted due to the constant vandalism by students and community members in both inner-city and rural areas. The disadvantages of aluminium jalousie windows are that they are not watertight, are easily damaged, have substandard operating devices, and provide low resistance to intruders, hence grilling of openings is required as can be seen in Figure 4.3. Additionally, aluminium jalousie windows have low resistance to salt water vapour and are prone to oxidising giving the school an unsightly appearance when not maintained. In light of these issues much more durable materials, such as concrete louvers are being employed. Concrete louvers, however, while being more durable give less ventilation and admittance of natural light. Figure 4.4 shows the elevation of two such types.

Figure 4.5. Elevation of Precast Concrete Louvers Used As Window Opening.

The researcher's site observations have revealed that school designers are finding a balance between aluminium jalousie windows, concrete louvers and breeze blocks. These include using breeze blocks at low levels and concrete louvers at high levels as in Figure 4.4. While this resolution of the problem does not provide the optimum solution, observations were that less vandalism to windows is recorded thus resulting in more secure buildings and the provision of better ventilation than the use of concrete louvers and breeze blocks alone. The major disadvantage of this approach is that lighting and cross ventilation is reduced significantly.

The fourth question of the MCAPE questionnaire solicited responses on the availability of windows in classrooms within each school. The results are presented below in Table 4.2.

Table 4.2

Schools and the Associated Availability of Windows

Availability of Windows	N	%
Windows are in less than ¼ of the classrooms	6	7.2
Windows are in at least ¼ of the classrooms	20	24.1
Windows are in at least 3/4 of the classrooms	48	57.8
Missing answer	9	10.1
Total	83	100

It was also noted that there were three major precast construction designs used in the education system. These are illustrated in Figures 4.6, 4.7 and 4.8 respectively.

Figure 4.6. Elevation of Precast Concrete Structure.

Figure 4.7. Elevation of Precast Concrete Structure –Newest Precast Building Design.

Figure 4.8. Elevation of Precast Concrete Structure – One of the Oldest Designs.

The traditional method of building construction gives the most lighting and ventilation, since it facilitates cross ventilation with larger window opening on two sides of the perimeter walls. Notwithstanding none of the precast structure highlighted in this research seem to provide adequate ventilation and the admittance of sufficient lighting.

Adequacy of lighting. Lighting quality is hindered or enhanced by the types of windows and doors or their absence or presence. If windows are used that give 100% ventilation and lighting, there will be less need for artificial lighting. Artificial lighting is normally provided by

1200 mm fluorescent tubing fixed to the underside of the ceiling or beams. The sixth question of the MCAPE questionnaire asked about lighting in the classroom. The results are shown in Table. 4.3.

Table 4.3

Number of Schools and their Respective Lighting Quality

Classroom Lighting	N	%
Yes, lighting is terrible	1	1.2
Yes, lighting is poor	22	26.5
Not sure	56	67.5
No, lighting is good	3	3.6
No, lighting is excellent	1	1.2
Total	83	100

On a site visit, a teacher commented that the lighting in the classroom was usually adequate. However, when lights were damaged they were not normally fixed on a timely basis and this led to classrooms being dark for unacceptable periods of time. Over 80% of the schools visited had temporary buildings that were poorly lit, and which were normally surrounded by walls with small windows to floor space ratios[15]. Those that had concrete louvers and concrete breeze blocks had in all cases low ceilings heights when compared to the permanent building structures. More consideration, therefore, needs to be given to the design of windows in precast

[15] Floor space ratio is the total amount of window space divided by the total amount of floor space. The larger the ratio the better the ventilation potential for that room.

constructions in order to increase light and ventilation. Figure 4.9 contrasts good and bad window openings.

Figure 4.9. Elevation of Decorative Blocks as the Only Window Opening Contrasts with a Good Distribution of Aluminium Windows.

Adequacy of bathrooms. Overcrowded schools have inadequate bathroom facilities. The Task Force on Education Reform (Davis, 2004) reported that less than 50% of schools have adequate bathroom facilities. The student to bathroom ratio[16] is less than desirable for most schools. There are many schools that are operating above their designed capacity i.e. the design considerations made for the number of students that the school was intended to accommodate at the onset. Clearly, when these schools operate above capacity the bathroom facility is bound to be inadequate. Moreover, the shift system has placed additional burden on the sewage infrastructure. Most of these schools were originally day schools and were converted to shift schools to accommodate the large amount of students at the secondary level.

Thirty two schools reported that the bathroom facility is inadequate to cater to the school population. On the other hand, 48 reported that bathroom facilities were adequate. Inadequate

[16] Student to bathroom ratio is the total amount of students in the school divided by the number of bathrooms. The higher the ratio the larger the number of students using one bathroom; a lower ratio is desirable.

bathrooms present major challenges for the students, especially the long waiting time to gain access to bathroom facilities. Students are often late back to classes after a bathroom break as reported by some principals during the site visits.

Proximity to noise. Noisy complexes included airports, heavy vehicular traffic, construction sites, operational railway stations or tracks, wood and metal workshops and sport or community complexes. The twelfth question on the MCAPE questionnaire asked about the proximity of noisy complexes to the classrooms. The results are shown in Tables 4.4, 4.5, 4.6 and 4.7.

Not many schools are affected by noise from airports. There are only three major airports and three aerodromes in Jamaica. Table 4.6 suggests that 43 of the schools polled could be experiencing noise nuisance from traffic. Also, passenger railways are no longer in use in Jamaica, but are used by the bauxite industry to transport ore. Bauxite mining is common in three educational regions. Bauxite mines and factories are not typically located near to schools although the tracks may be in proximity to schools.

Table 4.4

Schools and their Proximity to Metal and Wood Workshops

Proximity of Wood and Metal Workshop	N	%
Yes, there are wood and metal workshops close to classrooms	35	42.2
There are no wood and metal workshops close to classrooms	48	57.8
Missing answer	0	
Total	83	100

Table 4.5

Schools and their Proximity to Airports

Proximity of Airport	N	%
Yes, there is an airport close to classrooms	2	2.4
No, there are no airports close to classrooms	81	97.6
Missing answer	0	
Total	83	100

Table 4.6

Schools and their Proximity to Vehicular Traffic

Presence of Vehicular Traffic	N	%
Yes, there is vehicular traffic close to classrooms	43	51.8
No, there is no vehicular traffic close to classrooms	40	48
Missing answer	0	
Total	83	100

Table 4.7

Schools and their Proximity to Construction Sites

Proximity of Construction Activities	N	%
Yes, there are construction activities close to classrooms	5	6.0
No, there are no construction activities close to classrooms	78	94
Missing answer	0	
Total	83	100

Analysis of Cosmetic Variables

Window condition. The fifth question on the MCAPE questionnaire analyzed the conditions of windows in classrooms. The results are presented in Table 4.8.

Table 4.8

Schools and their Respective Window Condition

Window Condition	N	%
Yes, they are in a terrible condition	2	2.4
Yes, they are in poor condition	15	18.5
Not sure	2	2.5
No, they are in good condition	61	75.3
No, they are in excellent condition	1	1.2
Missing answer	2	2.4
Total	83	100

Site visits during the administration of questionnaires, including pilot testing, revealed troubling findings: except for the newer schools most of the windows of high schools are in a deplorable condition. They range from heavily corroded windows, which are dysfunctional because of missing blades and operators, to the absence of complete windows units. Aluminium jalousie windows that are at low levels are both broken and deteriorating. This is shown in Figure 4.10 below.

Figure 4.10. Elevation of Aluminium Windows and Their Condition in Four Different Schools.

External sections of high level windows are most times not cleaned and have fallen into a state of disrepair. Even if the internal section of the windows are cleaned, the other sections are often not done, seemingly because of the need for scaffolding which is expensive. The conditions of windows and doors worsen when in close proximity to the sea coast due to the corrosive influence of salt-laden air on aluminium jalousies. There seems to be no attempt to design windows, considering the type of materials used in order to satisfy the requirements of different climatic conditions. Hardwood is an alternative since it has a resistance to salty water vapour.

Schools that were constructed recently have a lower square area of window- to- floor ratio. The most recently built schools that have windows are in good condition. Obviously there is little or no maintenance program for school facilities. Unfortunately new buildings will suffer the same fate as older ones, if there is no maintenance plan. Only recently built schools have windows that are in good condition as well as a few old schools. It was felt by some teachers that concrete louver windows cause massive leaks to the classroom depending on the direction and intensity of the wind when it rains. The teachers explained that leaks from these windows during rain normally have students and teachers shifting to the other side of the classroom, thus disturbing the teaching process and resulting in reduced teaching time. Observations made during the site visits are consistent with responses from the completed questionnaires; however, the condition of some windows is significantly poorer than what was reported.

While doors were not an item listed on the questionnaire they were observed when site visits were made, since their presence contributes to the degree of ventilation and lighting in a classroom. They are usually constructed of timber, and the hollow section clad with steel plate or grilled in brick pattern. Doors constructed of steel plates and grills provided a prison-like environment and sent the wrong message to students. The doors and doorway closers are finished with oil paint.

Doors provide access into building interior spaces and should provide weather-tight seals when closed. Ching (1991) explained that doorways should be large enough to move through easily and accommodate the moving of furnishings for privacy and security, and any need for light, ventilation, and viewing should also be considered in assessing a door's performance. There is considerable variability with door condition in schools, but both rural and inner-city schools had doors in equally bad condition.

Temperature of classroom. The seventh question on the MCAPE questionnaire asked about the temperature[17] of the classroom. The results are shown in Table 4.9.

Table 4.9

Schools and their Respective Temperature Ratings

Classroom Temperature	N	%
Unbearably hot	10	12.2
Hot sometimes	58	70.7
Not sure	2	2.4
Hot most times	11	13.4
Cool all the time	1	1.2
Unbearably hot	1	1.2
Total	83	100

The temperature of classrooms varies throughout the year; naturally they are hottest in the summer. To offset high temperatures, mechanical ventilation could be employed such as fans and air-conditioning units, although care should be employed to choose systems with low noise levels. Mechanical ventilation and cooling systems, however, will have an impact on utility cost.

Poorly designed classrooms that are overcrowded amplify temperatures. Observations revealed that most of the time classrooms have neither functioning fans nor air-conditioning units and even when there are fans they are grossly inadequate. The schools visited usually had one fan per classroom with over forty students, and the temperatures of the rooms were therefore

[17]In the Jamaican context terrible temperature usually refers to very hot and sweaty conditions and good temperatures are moderate with good cross ventilation.

hot and uncomfortable. Fortunately most classrooms are not in use during the hottest months of the year.

School visits also revealed that several schoolrooms have no ceiling beds and temperatures within those classrooms were therefore unbearably hot. Temporarily constructed classrooms are often hot, since some of them have windows made of concrete louvers and concrete breeze blocks. The replacement of aluminium louver windows with concrete louver windows has compounded the ventilation problem which has resulted in high classroom temperature (see Fig. 4.11). Cross ventilation must be considered when classrooms in the tropics are being designed. Cross ventilation can be provided by installing windows on opposite sides of the rooms so that fresh air can enter from one section and exit the opposite section of the building.

Figure 4.11. Elevation of Precast Concrete Louvers Limiting the Supply of Fresh Air and Light into Rooms.

Classrooms formed against perimeter walls with no window openings on one side were observed at some schools. This situation increases the temperature of the classroom when the rooms were filled to capacity. In another observed situation, attempts to acquire much needed space for students, led to buildings being constructed in unsuitable empty spaces. More often than not, these spaces are available in very close proximity to the classrooms or other buildings.

In these situations, building extensions block window openings, thus, reducing ventilation and lighting to proposed and existing facilities.

Classroom painting schedule. Observation has revealed that painting was rarely carried out in its entirety but instead was mostly done in phases and most times done to meet the reopening of a new school term. Painting for most schools was done to common areas, staircases, corridors and bathroom walls. It is oftentimes done to mask dirt and graffiti. Ceilings and high level walls are often done less frequently, thus leading to buildings being aesthetically unsightly. The majority of the buildings visited in the rural areas were dirty and needed to be painted comprehensively. Figure 4.12 shows typical condition.

Figure 4.12. Elevation of Building with Peeling Paint.

The eighth question on the MCAPE questionnaire asked when the classrooms were last painted. The results are shown in Table 4.10.

Table 4.10

Schools and their Respective Painting Schedules

Painting Schedule	N	%
Less than 8 years ago	3	3.6
Between 8 years and 15 years ago	78	94.0
15 or more years ago	2	2.4
Total	83	100

Colour of classroom wall. Question 20 of the MCAPE questionnaire asked what was the colour of the walls in the classrooms. The results are summarized in Table 4.11.

Table 4.11

Colour of Classroom Walls

Colour of Walls	N	%
Dark colours	2	2.4
White	7	8.4
Pastel colours	43	51.8
Other	22	26.5
Missing answer	9	10.8
Total	83	100

The colours of school buildings are determined by the choice of the school as there is no standard colour for the painting of schools set by the Ministry of Education. Therefore the chosen colours are usually used to brand the school. The Ministry has now developed a building standard that stipulates that no school should be painted in red or green as these colours represent the two major political parties. However, observation revealed that the outer walls of schools are still painted in these colours, especially when these colours have been traditionally associated with their schools. It was observed that darker colours are usually used at lower levels of walls and lighter colours at higher levels. This strategy is employed to mask dirt at the lower section of the wall that is more likely to be exposed to dirt and dust.

Condition of internal walls. The ninth question asked about the condition of internal walls. The results are shown in Table 4.12.

Table 4.12

Schools and Internal Wall Condition

Condition of External Walls	N	%
Yes, they are in a terrible condition	1	1.2
Yes, they are in poor condition	11	13.3
Not sure	1	1.2
No, they are in good condition	64	78
No, they are in excellent condition	5	6.1
Missing	1	1.2
Total	83	100

Some internal walls are usually constructed from ply partition and do not go up to ceiling height, thus allowing noise from neighbouring classrooms to enter. This is normally disruptive and hinders some students from hearing the instructions or explanations from their teachers. Internal timber walls are usually constructed from wolmanized pitch pine frame, clad on both sides with 3/8" form ply, finished with oil-based paint. Internal partition walls employed in some schools are generally unattractive and do not satisfy the basic sound insulation requirements. Temporary partition walls are installed in large rooms to create separate classrooms and are usually the initiative of principals to resolve space problems. In some cases the classrooms are open and only separated by a chalkboard. This creates classrooms with only two or fewer permanent walls leaving classrooms exposed to the elements and poorly secured. These classrooms are easily disturbed by external activities, particularly noise. In summary, the conditions of some of these walls need much to be desired and most likely do not inspire students to approach their lessons seriously or have confidence in the school management.

Figure 4.13. Condition of Internal Walls and Chalk Board Used as a Partition for Classrooms.

Condition of external walls. Walls are the vertical planes of a building which define and enclose its interior spaces (Ching, 1991). The internal and external walls of a building are normally painted with emulsion or oil-based paint, applied in two or three coats. Walls are normally constructed of 150 mm thick precast blocks, bedded in (1:3) cement and sand mortar and finished with 12 mm thick cement and sand rendering in two coats. Most times these are "in filled" between reinforced concrete beams and columns--one of the most durable and permanent methods of constructing walls in Jamaica. The conditions of walls are heavily dependent on the kind of maintenance they receive.

Figure 4.14. Poor Condition of External Walls.

The tenth question of the MCAPE questionnaire asked was about the condition of external walls. The results are shown in Table 4.13.

Table 4.13

Schools and their Respective External Wall Condition

Condition of Internal Walls	N	%
Yes, they are in a terrible condition	1	1.2
Yes, they are in poor condition	11	13.3
Not sure	1	1.2
No, they are in good condition	64	78
No, they are in excellent condition	5	6.1
Missing answer	1	1.2
Total	83	100

Buildings that are constructed under the supervision of the Ministry of Education seem structurally sound and, most of the time, have adequate openings to receive windows for sufficient lighting and ventilation; this is true for the permanently constructed buildings.

However, it was noted that some prefabricated structures have significantly reduced window openings.

Condition of ceiling. The eleventh question of the MCAPE questionnaire asked about the condition of ceilings. The results are shown in Table 4.14.

Table 4:14

Schools and their Respective Ceiling Condition

Condition of Ceiling	N	%
Yes, they are in a terrible condition	2	2.4
Yes, they are in poor condition	10	12.0
Not sure	1	1.2
No, they are in good condition	68	81.9
No, they are in excellent condition	0	0
Missing answer	2	
Total	83	100

During observation, it was confirmed that the majority (82%) of ceilings were in good condition. The ceilings in good condition were mostly concrete ceilings without leaks. They are usually rendered with 12.5 mm thick cement and sand (1:3) and finished with white emulsion paint. There were instances where there were no ceiling beds and the underside of aluminium sheeting served as ceiling; even with adequate windows these rooms are usually hot, since the ceilings are not insulated. Figure 4.15 shows the condition of a ceiling with no ceiling bed.

Figure 4.15. Condition of Ceiling and Ceiling with No Ceiling Bed.

Classroom cleaning schedule. The thirteenth question of the MCAPE questionnaire asked about the cleaning schedule of the classroom. The results are presented in Table 4.15.

Table 4.15

Classroom Cleaning Schedule

Classroom Cleaning Schedule	N	%
They are cleaned three times a day	4	4.8
They are cleaned twice a day	23	27.7
They are cleaned once a day	54	65.1
They are cleaned every week	1	1.2
Other, please specify	1	1.2
Total	83	100

Condition of bathrooms. Inadequate bathroom facilities will exacerbate poor bathroom conditions, especially if effective maintenance programs are not in place. While the cleanliness of the bathrooms can be improved by assigning custodial staff full-time to attend to the state of the restroom, issues associated with high usage are more problematic. These include frequent blocking of pipes and manholes (which results in flooding of the bathroom), frequent broken taps and sanitary appliances. The cumulative effects of such situations include increased health risks and obnoxious odours. This problem is compounded when the maintenance programs are ineffective.

The fifteenth question of the MCAPE questionnaire asked about the condition of bathrooms. The results are presented in Table 4.16.

Table 4.16

Condition of Bathrooms

Condition of Bathrooms	N	%
Yes, they are in a terrible condition	1	1.2
Yes, they are in poor condition	14	16.9
Not sure	5	6
No, they are in good condition	61	73.5
No, they are in excellent condition	0	0
Missing answer	2	2.4
Total	83	100

In a school visited with sections constructed less than ten years ago, doors that were to enclose the cubicles were broken off and the building had insufficient water for flushing and to cater to other sanitary conveniences. Site visits revealed that bathroom facilities were often in worse condition than reported in the returned questionnaires which stated that 74% of the bathrooms are in good condition.

Bathroom cleaning schedule. Frequent cleaning is one measure that could be employed by schools to counter the effect of insufficient bathrooms; although the ideal situation is to have cleaning done as frequently as possible by employing cleaning staff dedicated to the restrooms.

School visits revealed that such methods were employed in only a few schools. Consequently many schools have undesirable bathroom conditions. The results from the MCAPE were 2.2% of schools cleaned bathrooms hourly, 14.6% three times a day, 49.4% once a day and 12.5% had other cleaning schedules.

Condition of grounds. The nineteenth question of the MCAPE questionnaire asked about the condition of the school grounds. The results are presented in Table 4.17 below. The responses to the questionnaire are consistent with site visits.

Table 4.17

Condition of School Grounds

Condition of School Grounds	N	%
There is no landscaping and sidewalks are either not present or damaged (it is unattractive to the community)	5	6
There is no landscaping and sidewalks and sidewalk are present and in good repair (it is acceptable to the community)	18	21.7
The landscaping and other outside facilities are attractive and well maintained (it is a centre of pride for the community)	54	65.1
Missing answer	6	7.2
Total	83	100

Site inspections of the schools have identified attempts made to bring structure to the grounds. These attempts are often eroded by the complexities required for effective maintenance of school grounds which include paving walkways, defining the pedestrian paths, maintaining manicured lawns as seen in Figure 4.16. What are most often created are dirt tracks and attempts at creating a lawn as seen in Figure 4.17. These lawns are sometimes in the form of playing fields that add to the discomfort of students by becoming dust bowls in dry weather; which is commonplace in environments where there is little rainfall or during drought periods. One principal was observed using transparent plastic sheeting to attempt to block dust from the lawn/playing field in classrooms ventilated by breeze blocks. This action, while addressing one problem contributed to another major problem as blocking windows reduced ventilation and added to the high temperature in the classroom.

Figure 4.16. Paved Walkways and Well Kept Grounds.

Figure 4.17. Dusty Ground Conditions.

Condition of classroom furniture. Classroom furniture in classrooms across Jamaica is generally made from timber writing surfaces and metal framing, the size of which varies according to the age of the students. Inspection revealed that furniture is facially scarred and sometimes functionally damaged. The furniture is often tightly packed in classrooms leaving little space for movement. The desks are arranged in a rectangular array that provides minimal visibility to students that are out of the effective line of sight[18], particularly when classrooms are oversized. In some instances desks and chairs were welded to each other in series which prevented students and teachers from assembling in small groups.

The eighteenth question of the MCAPE questionnaire asked about the condition of the classroom furniture. The results are presented in Table 4.18 below.

Table 4.18

Condition of Classroom Furniture

Condition of Classroom Furniture	N	%
Most rooms have furniture that is either scarred or functionally damaged	11	13.3
Though at least half of the rooms have some minor facial scars on the students' desks, all of the furniture is functionally sound and looks satisfactory	56	67.5
All the classrooms have furniture which is functionally sound and attractive	14	16.9
Missing answer	2	2.4
Total	83	100

[18] Effective line of sight is a position in the classroom where the student has little or no difficulty in seeing the blackboard or chalk board.

Presence of graffiti. Graffiti is a common feature of some classroom walls, corridors, bathroom walls, and the walls along staircases. Even when principals institute a zero tolerance policy with regards to graffiti, students still express themselves on walls in the form of letters, words and pictures. One approach employed by principals to combat graffiti in schools is to punish students and require them to repaint the area that they were caught defacing with paint that they have to purchase with their own money. One principal explained that this approach has been successful at stemming such incidents in his school. Other vigilant methods have to be found, since students still surreptitiously carry out the act. The presence of graffiti is unattractive and usually informs school managers of the various gangs represented in the school through their symbols of identification.

The seventeenth question of the MCAPE questionnaire asked if graffiti was commonly found throughout the school. The results are presented in Table 4.19.

Table 4.19

Presence of Graffiti

Presence of Graffiti	N	%
Graffiti is commonly found	19	22.9
Graffiti is sometimes found	45	54.2
Graffiti is rarely found	17	20.5
Graffiti is never found	1	1.2
Missing answer	1	1.2
Total	83	100

Even though principals argue that graffiti is painted out when it is found, visits to the schools have shown otherwise as a plethora of graffiti still decorate the walls as seen in Figure 4.18.

Figure 4.18. Condition of External Wall with Painting Done To Cover Graffiti.

Non-Facility Factors and Student Attainment

When principals were asked to list factors that they thought impacted their student's attainment eleven main factors emerged. These factors included literacy, resources and finance, school attendance, teacher commitment, difficult commute to school, health and nutrition, inadequate school building, student characteristics and home environment.

When respondents were asked to compare how important the state of the physical plant was to other factors identified in question 30, there were 75 responses. Sixty respondents felt that the condition of the physical plant was important or very important for student attainment. Four respondents felt that the state of the building was just as important as any other factors.

Verification of Questionnaires by Site Assessment

Table 4.20 shows the percentage adequacy ratings given to school facilities by their principal as opposed to that determined by the researcher based on site visits to 50 schools. It was noted that not all independent variables could be assessed based on the timing of the visits. On some occasions school facilities like the workshop were closed. Ratings for adequate, frequent or good were grouped to give a cumulative rating; similarly ratings for inadequate, infrequent or bad were also grouped. Table 4.20 also shows whether these reported findings were consistent with observations made by the researcher on site visits as shown in Table 4.21.

Table 4.20

Principals' Assessments of School Facilities

Variables	Adequate, Frequent or Good %	Inadequate, Infrequent or Bad %	Consistence with Researcher Assessment (C=Consistent, N=Not Consistent)
Adequacy of windows	57.8	31.3	C
Window condition	75.3	20.9	N
Adequacy of lighting	4.8	68.7	Most principals were not sure if lighting was adequate or inadequate
Classroom temperature	16.1	83.9	C
Painting schedule	2.4	97.6	C
Condition of internal wall	84	16	N
Condition of external wall	84	16	N
Condition of ceiling	81.9	18.1	C
Classroom cleaning schedule	32.5	67.5	C
Bathroom adequacy	57.8	41	N
Bathroom condition	73.5	18.1	N
Bathroom cleaning schedule	55	45	C
Presence of graffiti	77.1	22.9	C
Condition of classroom furniture	13.3	86.7	C
Condition of school ground	27.7	65.10	C
Colour of classroom wall	65	35	C
Overall condition %	49	46.7	

Table 4.21

Researcher's Assessment of School Facilities Based on Site Visits

Variables	Adequate, Frequent or Good	Inadequate, Infrequent or Bad	Comment
Adequacy of window	Adequate		Windows in classrooms are adequate, except for precast buildings and those that are blocked by addition to building of precast blocks and precast louvers.
Window condition		Bad	Most windows are in bad condition especially externally at a high level.
Adequacy of lighting	Adequate		Most buildings have adequate lighting except those with breeze and precast louvers and additions to buildings that conflict with the architect's original design considerations.
Classroom temperature	Comfortable		Temperature is fairly OK in buildings with sufficient windows, except those that are of precast construction, and have an addition that conflicts with the original design considerations.
Painting schedule		Infrequent	Most building are infrequently painted except for back-to-school covering of extremely dirty spots and graffiti.
Condition of internal wall		Bad	Most walls are in bad condition as a consequence of infrequent painting.
Condition of external wall		Bad	Most walls are in a bad condition as a consequence of infrequent painting.
Condition of ceiling		Bad	Most ceilings are in good condition except for the few that have leaking damage. Some schools have no ceiling beds.
Classroom cleaning schedule	Good		As a consequence of overcrowding, most schools need a more frequent cleaning schedule.
Bathroom adequacy		Inadequate	As a consequence of overcrowding most bathrooms are in a terrible condition.
Bathroom condition		Bad	As a consequence of overcrowding and infrequent cleaning most bathrooms are in a terrible condition.
Bathroom cleaning schedule		Bad	Most schools reported that they have an adequate cleaning schedule, however site visits to schools show that bathroom facilities are inadequate.
Presence of graffiti	Infrequent		Most school have a graffiti removal programme, but most schools have large amount of graffiti.
Condition of classroom furniture		Bad	Most furniture is scarred and functionally damaged.
Condition of school ground		Bad	Most schools have only a basic concept of landscaping and are in need of proper landscaping.
Colour of classroom wall			There is no standard for painting of schools. Each school has its own standard.
Overall condition %			Average

From the site inspections conducted, during the administration of questionnaires and school visits, it was noted that much variability existed among the schools. Six main themes emerged from visits and administration of questionnaires:

- Inadequate space.
- Poorly maintained facilities.
- The construction of poorly designed temporary facilities.
- High variability of design.
- Facilities that are maintained by custodians that are not sufficiently trained in ground maintenance.
- Most custodian staff members are not provided with suitable tools, materials, and equipment to perform their duties safely and effectively.

To a large extent the results from the questionnaires were consistent with the site observations. The maintenance of the existing school stock is grossly inadequate and if not addressed urgently will endanger students and staff. Site observations revealed that space shortages have placed increased pressure on the education system, thus, worsening the state of the facilities, particularly bathroom facilities.

It was observed that buildings that are constructed under the supervision of the Ministry of Education are reasonably sound and display sound building practices, but it was noted that renovations and alterations that are done periodically by school principals without the intervention of the Ministry of Education conflicts with the schools' original design considerations. The major problem in the system is poor maintenance and poorly designed buildings. The findings reveal that most of the buildings are structurally sound but suffer from maintenance deficiencies: wall finishes, broken windows, doors, internal partitions, sanitary facilities, floor finishes, and windows that limit light and fresh air. More than 50% of the school building stock is old and have exceeded their expected life span of thirty years. However, the method of construction and new injections of capital have allowed most of these old schools to remain structurally sound even after many cycles of usage, and they still provide suitable teaching facilities, despite cosmetic defects. While chapter five provides the quantitative analysis derived from the independent variables listed on the administered questionnaires, chapter six details the main defects identified and how they can be corrected.

Chapter 5

Research Findings – Other Statistical Analysis

Introduction

The purpose of this chapter is to present the findings, using the sample of 83 returned questionnaires, and personal site visits to schools, and analyzing categories of schools with similar conditions based on specific independent variables. The objective was to establish whether variations in building conditions corresponded with differences in students' attainment.

As explained in the methodology of the research, normality was checked by looking at the actual shape of the distribution of histograms generated from schools' academic scores for the six independent variables i.e. the six subjects used in this research. This determined the type of statistical tools to be used for data analysis, parametric or non-parametric, for each group of dependent variables. The resulting distributions were not normal in appearance in that they were not equally distributed around a line of symmetry and so, non–parametric tests were used for the analysis. Figure 5.1 shows the histograms generated from the analysis.

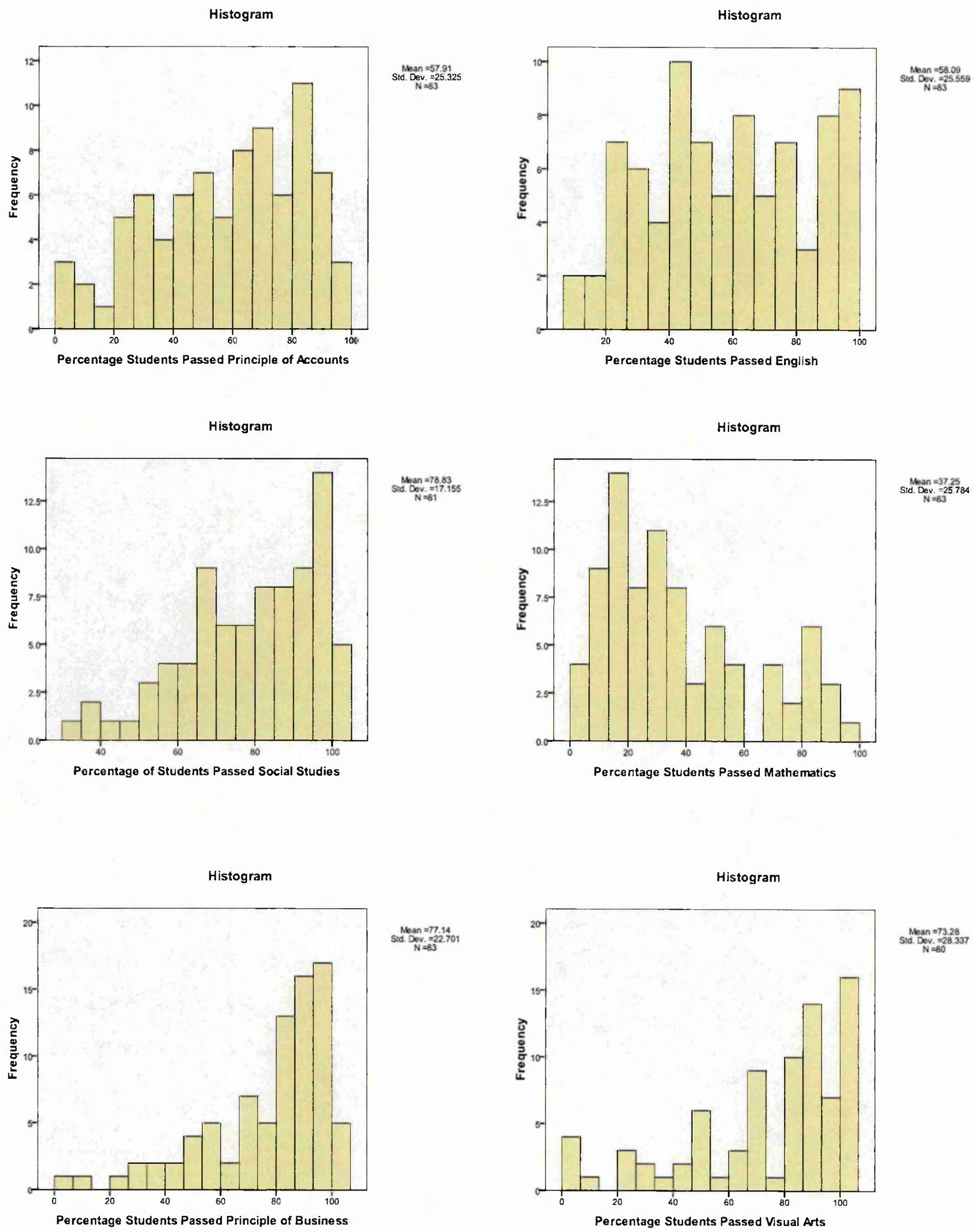

Figure 5.1. Histograms for Six Academic Subjects.

Table 5.1 gives a summary of the statistical tests used in this research.

Table 5.1

Non-Parametric Tests Employed in Thesis

Dependent Variables		Descriptive	Kruskal-Wallis	Mann–Whitney U Test	Spearman's Rho	Multivariate Analysis
Building	Type A	X				
	Type B	X				
	Region	X				
	Building age	X			X	
	Window presence	X	X			
	Window condition	X	X			
	Lighting	X	X			
	Classroom Temperature	X	X			
	Painting Schedule	X	X			
	Internal Wall Condition	X	X			
	External Wall Condition	X	X			
	Ceiling Condition	X	X			
	Traffic Nuisance	X		X		
	Railway Track	X		X		

	Construction Activities	X		X	
	Metal or Wood Workshops	X		X	
	Sports Complex	X		X	
	Classroom Cleaning Schedule	X	X		
	Bathroom Adequacy	X	X		
	Bathroom Condition	X	X		
	Bathroom Cleaning Schedule	X	X		
	Grounds	X	X		
	Wall colour	X	X		
Subject	English				X
	Mathematics				X
	POA				X
	POB				X
	Social Studies				X
	Visual Arts				X

This section of the thesis reports the findings of twenty-three independent variables relating to building condition including six relating to noise generating facilities. The results show that building age is statistically significant for all subjects except Visual Arts when the Kruskal-Wallis test was $p < .05$. Findings for building age are presented separately. Other variables from the questionnaire related to school building condition were grouped under school design factors i.e. structural variables such as proximity to noise generating facilities, condition and maintenance factors i.e. cosmetic variables. The impact of socioeconomic factors is then discussed. Figure 5.2 shows significant building factors that are associated with students' performance.

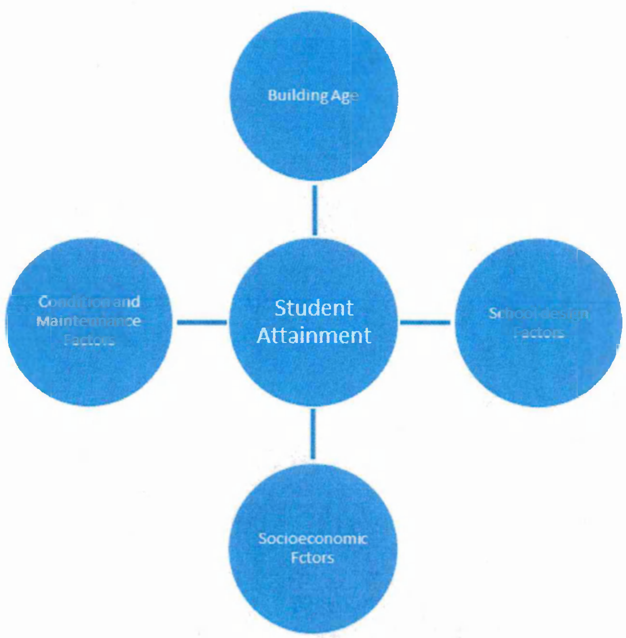

Figure 5.2. Significant Factors that Generally Influence Student Attainment

Statistical Significance

The statistical decisions used in this thesis are given below and the explanation of the statistical tests used in this research is detailed in Appendix K. The statistical tests employed were univariate analysis , Kruskal-Wallis, Mann-Whitney and multivarate analysis. While it is customary to determine significance when $p < .05$, Gelman and Stern (2006), argued that "only a small change is required to move an estimate from a 5.1% significance level to 4.9%, thus moving into statistical significance." (p. 328). Also, large changes in significance levels can correspond to small, non-significant changes in the underlying quantities. Accordingly, they advise that this is an error and statistical error leads us to suggest that students and practitioners be made aware that the difference between "significant" and "not significant" is not itself statistically significant.

Sterne and Smith (2001) also argued that P values, or significance levels, measure the strength of the evidence against the null hypothesis and the smaller the P value, the stronger the evidence against the null hypothesis, therefore an arbitrary division of results, into "significant" or "non-significant" according to the P value, was not the intention of the founders of statistical inference. So a P value of 0.05 need not provide strong evidence against the null hypothesis, but it is reasonable to say that $P < 0.001$ does. Sterne and Smith (2001) argue that in the sections of papers describing results the precise P value should be presented, without reference to arbitrary thresholds. They suggest that results of medical research should not be reported as "significant" or "non-significant" but should be interpreted in the context of the type of study and other available evidence. Since bias or confounding should always be considered for findings with low P values, they feel that this will stop the discrediting of medical research by chance findings.

The findings of Gelman and Stern (2006) and Sterne and Smith (2001) are applicable to this research since more variables could be considered to have statistical significance or greater importance, in that they would fall within, say, $p < .10$. It is therefore important to note that the following variables in this chapter are not statistically important, but based on their "p" value exhibit strong association. See Appendix L and Appendix M for a quick glance at these variables. The researcher is positing that those that fall just outside of the significant limits set by this research are also important factors showing high association with the academic subjects.

Building Age

School building age was analysed to determine if there was a significant relationship between it and the six academic scores of the students who attended the sampled schools. Age was used as it gave an indication of the state or condition of the building. It can be used as a proxy for construction characteristics, because it tends to follow distinct trends through time (Dunse and Jones, 2002). Analysis of building age and academic scores using Spearman's correlation coefficient revealed statistically significant correlation with five of the six subjects (see Table 5.2). A strong positive correlation between building age and scores obtained in English Language, Mathematics, Principles of Accounts (POA), Principles of Business (POB), and Social Studies was obtained. This suggests that there is a strong association between building age and student attainment. However, Visual Arts displayed a weak positive correlation, suggesting that student's academic scores in the said subject are less sensitive to age of school facilities or any deficiency of its state caused by age.

Table 5.2

Correlation between Age and Six Academic Subjects Using Spearman's Rho

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Building Age (coef.)	.512	.000	.263	.390	.304	.122
(Sig.)	.000	.000	.000	.000	.006	.280

Note. Spearman's rho correlation is significant at the 0.01 level (2-tailed).

Table 5.2 shows the association between building age and six academic scores. Comparison of the statistically significant results showed that four of the six subjects recorded statistically significant results $p < .000$ and one at $p < .006$. Visual Arts was the only subject that did not record a statistically significant result. The mean ranking of two of the subjects, English Language and Mathematics, indicated that in school buildings that are younger[19]; students tended to score lower mean ranks (see Table 5.3). Schools that are older also tended to have higher mean ranks for these subjects.

The findings of the thesis with regards to building age are similar to Kilpatrick (2003) but contrast with the majority of researchers who found that age was not significant or that younger buildings were associated with better student attainment (Hickman, 2002; Stapleton, 2001).

The researcher is aware that correlation does not mean causation; thus other statistical analyses were conducted. In this thesis building age and students' academic attainment were the only independent variables that used Spearman's rho for analysis. All other independent variables were analysed using the Kruskal–Wallis and Mann–Whitney tests.

Table 5.3 illustrates the mean ranks for English Language and Mathematics. English Language recorded the mean ranks of 13.93 to 72.50 from the youngest schools to the oldest schools. Similarly, Mathematics recorded mean ranks of 27 to 72.50 for the youngest schools to the oldest schools (Kruskal–Wallis test, $p < .01$). Appendix N shows the mean rank for the other four academic subjects and Appendix O shows the results of other Kruskal-Wallis tests that were done.

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[19]Younger schools are those within the age group of 1 – 21 years.

Table 5.3

Seven Groups of School Ages and their Associated Mean Rank for English Language and Mathematics

Dependent Variables	N	English Language Mean Rank	Mathematics Mean Rank
Under 20 years	7	13.93	27.00
21-20 years	33	31.82	30.89
41-60 years	24	48.19	44.77
61- 80 years	8	59.81	62.25
81 – 100 years	5	68.30	67.30
101 – 120 years	4	54.25	55.88
121-140 years	2	72.50	72.50
Total	83		

Note. English mean rank for each group is compared. This is a "between group" analysis. So different people must be in each of the different groups (Pallant, 2007).

As reported in chapter four, more than 50% of the school building stock is old and have exceeded their expected life span of thirty years. However, the method of construction and new injections of capital have allowed most of these old schools to remain structurally sound even after many cycles of usage, and they still provide suitable teaching facilities, despite cosmetic defects. In American schools, concerns are that older schools are in more disrepair, lack the necessary infrastructure for advanced telecommunications system, have inefficient mechanical systems, and may lack modern safety features (National Centre for Education Statistics, U.S. Department of Education, 2007).

Based on the large old stock of schools in Jamaica similar concerns to those in America could be expressed, since more than 50% of the building stock has exceeded its useful life and is now in its replacement period, and is generally suitable for modern school use. According to PricewaterhouseCoopers (2000), the changing school context will inevitably impact upon the way teaching and learning takes place and consequently the way in which schools are designed. There is today more focus on personalized learning, as well as learning outside of the immediate classroom, given that workforce reform has resulted in a growing number of staff, other than teachers, becoming educators in schools. For them the use of multimedia rather than single media is changing what pupils and staff require from school buildings and infrastructure, and this is having an impact upon the provision of information technology, which was unimagined when most of the schools were built.

Recall that the very young and very old schools were removed from the population to check that there were no intervening variables that were associated with these two groups and were influencing the outcomes. The decision to remove the young and very old schools was made when the researcher realized that when Spearman's Rho was used, there was constant and significant correlation found with age (see Table 5.3). The average age of 57 schools was divided into two groups ranging from 21- 40 years (33) and labelled younger schools, and those from 41 – 60 years labelled old schools (24). The mean scores for English Language, Mathematics, Principles of Accounts (POA), Principles of Business (POB), Social Studies and Visual Arts were 47.37, 24.90, 50.72, 69.10, 71.15, and 71.07 respectively for younger schools. Older schools recorded 64.60, 40.08, 62.02, 83.24, 81.59 and 70.58 respectively. When the analysis was conducted using the Mann-Whitney test for the two groups (younger and older schools for the six academic scores), all six academic scores were statistically significant. That is, in all categories older schools were associated with higher academic scores that younger schools.

A one–way between–groups multivariate analysis of variance was also performed to investigate age differences. The six dependent variables were used with the independent variable age. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the seven age groups on the combined dependent variables, $F(3,428) = 3.57$, $p = .004$: Wilk's Lambda = .98: partial eta square .02. This suggested that younger schools displayed lower academic scores. Specifically, the analysis revealed that English Language, Mathematics, Principles of Accounts (POA), Principles of Business (POB), Social Studies and Visual Arts recorded lower academic results in newer/younger schools than in older schools.

This finding is not consistent with aspects of the body of the literature that informed that newer schools, presumably with better facilities should have higher academic attainment and vice versa. In fact Al- Enezi (2002) had similar results in his study, using multiple regression analysis, but concluded that the results were inconclusive and did not make any sense. He explained that there was a significant negative relationship between the response to age of school building and student's achievement, that is, when the principals ranked their school building as older, the student's achievement in these schools was higher. Table 5.4 shows the mean and standard deviation for the six subjects used in the thesis. These findings do not support the findings of Hines (1996), McGuffey and Brown (1978), Plumley (1978), Bowers and Burkett (1987), Chan (1979), Edwards (1992), Cash (1993), Earthman and Lemasters (1998) and Bullock (2007) regarding the impact of building age and students' achievements. That is to say, their findings suggested that the newer and better the facilities the higher the academic scores of students.

Table 5.4

Seven Groups of School Ages and Mean and Standard Deviation for English Language and Mathematics

Age		English Language		Mathematics	
	N	Mean	Standard Deviation	Mean	Standard Deviation
Under 20 years	8	27.01	13.61	21.94	17.76
21-20 years	30	47.37	20.52	24.90	16.58
41-60 years	30	64.60	22.23	40.07	27.00
61- 80 years	8	77.01	22.17	59.39	25.09
81 – 100 years	4	85.94	18.15	67.30	24.40
101 – 120 years	2	72.10	21.54	49.90	23.50
121-140 years	1	92.40	2.55	71.85	17.18
Total	83				

Site visits after data analysis. The data analysis consistently showed that younger schools tended to have poorer academic scores than older schools. Consequently follow-up site visits were made to both older schools showing high academic achievement and younger schools with poor academic achievement in order to determine, by observation, trends related to the facilities that may account for the incongruity of this thesis' results with that of other studies with regard to building age. Major differences were noted in the allowance made for natural lighting of classrooms, landscaping of the facilities, accommodation made for outdoor study areas and the presence of graffiti.

Features of older, high performing schools. While it is recognised that sturdy windows are necessary it is also necessary for classrooms to have good lighting and ventilation. On site visits, older high-performing schools were observed to have the following characteristics.

- Fixed glass panels above concrete louvers.
- Trees and lawns incorporated in landscaping.

- Large trees around the perimeter of the building providing shade for the building and cooling classrooms.
- Outdoor study/sitting areas that set the mood for study.

These characteristics are illustrated in Figure 5.2.

Fixed glass panels above concrete louvers

Trees and lawns incorporated in landscaping

Large trees around the perimeter of the building provided shade for the building and cooled the classrooms

Outdoor study / sitting areas set the mood for study

Figure 5.3. Features of Older, High-Performing Schools.

Features predominantly observed in younger low performing schools included:

- Precast construction: Four main moulds were used, and whilst this may have been cost effective, the designs of the moulds have inadequate window space and low ceiling height which led to dark, hot classrooms. Additionally, the homogenous nature, denseness and reduced perforation of precast concrete walls retain heat in the classroom and contributes to low air exchange.
- Poorly executed expansion and renovation done by principals to accommodate increased student populations.

- Breeze and decorative blocks that limit light and fresh air.
- Steel- clad building.
- Expansion into building circulation space.
- Limited outdoor sitting space.
- Poorly landscaped school grounds.
- Buildings with no perimeter walls often with just metal grills and form ply.

Some of these characteristics are illustrated in Figure 5.3.

Precast structure with limited window opening. Classrooms are hot with limited light and ventilation.

Aluminum-clad building. These classrooms are very hot.

Makeshift building with grill and ply as walling. Students are affected by dust and distracted by outide activities.

Concrete decorative blocks used as window openings. Classrooms are poorly ventilated with little admittance of light.

Figure 5.4. Features Observed in Younger, Lower-Performing Schools.

School Design and Structural Variables

Proximity to noise-generating activities. Mann-Whitney U tests were done for schools in proximity of noise-generating activities (see Appendices P, Q and R). Multivariate analysis using a Wilks' Lambda test was also done for schools in proximity of noise-generating activities (see Appendix S). The median results for groups of noise-generating facilities are given in Appendix T.

Wood or metal workshops were significant when multivariate analysis was conducted for all six subjects. Multivariate analysis did not show the airport as a significant factor for any subject. Vehicular traffic emerged as a significant factor for Maths and English when multivariate analysis was conducted. When multivariate analysis was conducted for proximity of railway tracks, only Visual Arts was significant. Construction activities were significant when multivariate analysis was conducted for four subjects – Mathematics, Principles of Accounts (POA), Principles of Business (POB), and Social Studies.

Window presence. Thirty-one point one per cent (31.3%) of the school stock surveyed had windows in at least one-quarter of the classrooms. This suggests that there was a problem of poor ventilation and lack of adequate natural lighting in these classrooms. School principals informed the researcher during conversations that windows made from aluminium were once common throughout the school stock but were removed and replaced with those having concrete louvers and decorative blocks as a response to vandalism. They acknowledge that this has resulted in significantly less light and ventilation in the classrooms and that high temperatures in the classrooms is an issue.

Dependence on artificial lighting increases schools' operating costs and impacts negatively on the country's energy bill. As noted in an earlier chapter there were low window to floor ratios[20] observed in some of the schools visited, which would indicate poor lighting and ventilation in these classrooms. This increases discomfort of students and dependence on artificial lighting and lends itself to mechanical means of ventilating, which allow for the

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[20]Window to floor ratio is calculated by dividing the total window area by the total floor area.

inefficient use of natural lighting and fresh air. If facilities fail to provide artificial lighting in these cases then students would be at a disadvantage, since they would not be able to see the chalk boards clearly, and at times they endure the discomfort of the hot classroom temperature, both of which hamper the learning process.

Dunn et al. (1985) found that good lighting contributed significantly to the aesthetics and the psychological character of the learning space. The comfort of classrooms is dependent on artificial and mechanical means, especially when window openings are small and do not sufficiently provide light and fresh air. Small window openings therefore create a dependency on artificial lighting, which serves to increase maintenance costs. Monies used to pay energy bills could be used to address other building defects. Jamaica is a tropical country which should take better advantage of the natural lighting.

Table 5.5 shows the mean ranking for both English Language and Mathematics with respect to the presence of windows. Rankings indicated that school buildings that have less than one-quarter of the classroom with windows, recorded the lowest mean rank. Those with the highest proportion of windows with windows in at least one-quarter of the classrooms recorded the highest mean rank for English. For Mathematics, schools with window openings in at least one-quarter of the wall space scored 40%, and those with less window openings scored 29%. Appendix O shows the mean rank for the other four academic subjects. Figure 5.5 shows a flow diagram of the causes, implications and consequences of inadequate window opening.

Table 5.5

The Proportion of Windows for Three Groups of Schools with Mean Rank for English Language and Mathematics

Dependent Variables	N	Mean Rank - English Language	Mean Rank - Mathematics
Less than ¼ of classrooms	6	31.92	29.00
At least ¼ of classrooms	20	42.15	40.28
At least ¾ of classrooms	51	38.36	39.68
Missing answer	6		
Total	83		

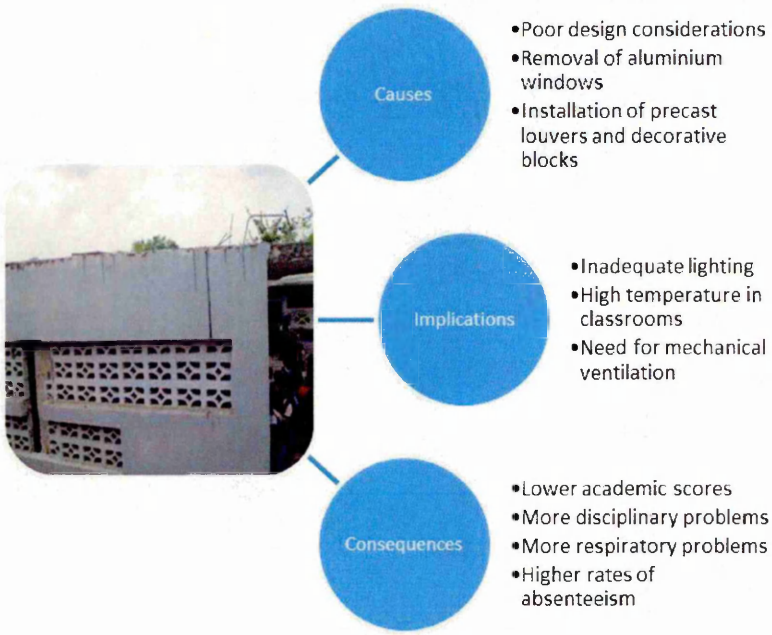

Figure 5.5. Causes, Implications and Consequences of Poor Window Solutions.

The entire population was used for this analysis. It was observed that all schools visited had window openings, which provide fresh air and lighting into the building. However, the proportions of the window openings varied according to the type of construction and the school's age. Some schools used precast methods that have low window opening to wall ratios. Approximately 31.3% of the respondents of the questionnaire reported that windows are in less than one-quarter of the classroom. One response to the problem of inadequate space at the secondary school level as well as that of limited financial resources saw the construction of buildings with walls clad with zinc sheeting and small window openings. This is an indication of poor strategic planning. Accordingly adequate provision was not made for the significant increase in the school population at the secondary school level.

During the administration of the MCAPE, respondents were asked to give an assessment of the proportion of windows in each classroom. Responses to this question were collapsed into two main categories, adequate and inadequate. Table 5.5 shows the details of the analysis for English Language and Mathematics, while the results of the other four subjects are shown in Appendix O, which indicates that in all six subjects the scores were not statistically significantly. This suggested that whether the classroom has sufficient windows or not, proportion of window openings does not impact students' attainment. The statistical findings does not support the argument that students who occupy classrooms with smaller window opening would have lower scores, since they would experience poor lighting and less fresh air which should impact learning negatively. The mean scores for English Language, Mathematics, Principles of Accounts (POA), Principles of Business (POB), Social Studies and Visual Arts in classrooms with inadequate windows openings, were 48.58, 27.22, 48.84, 70.74, 74.54 and 83.04 respectively, and for classrooms with adequate window opening 46.86, 25.83, 45.89, 66.55, 75.29 and 67.75 respectively.

The availability of window openings is an indication of the amount of light and fresh air that is allowed in the classrooms. In light of this information, school buildings that are modified and are not consistent with original architectural design considerations should be restored to their original state. The proportion of window openings used for the assessment of schools in the

Jamaican education system was based on the design by Cash (1993). This is to say, no modification was done to this question from the CAPE questionnaire.

Adequacy of lighting. Fifty-seven respondents reported that the lighting was good while 23 respondents reported that the lighting in the classrooms ranged from terrible to poor. The finding that 68 % of the respondents reported that the quality of lighting is good is surprising since a large proportion of the schools in the system have precast concrete blocks which significantly reducing the quantity of lighting that enters the classroom. This could also mean that principals were not able to assess the quality of lighting in the classrooms. Also, the respondents were asked to determine the quality of the lighting, thus determining if the lighting was adequate or inadequate. Mann-Whitney tests were conducted, in the categories of adequate and inadequate with the six academic scores; none of them showed any statistically significant result. This could be attributed to the large number of respondents that were not sure about the lighting levels in the classrooms. This result could be suggesting that whether the lighting is adequate or inadequate, students' academic scores are marginally different.

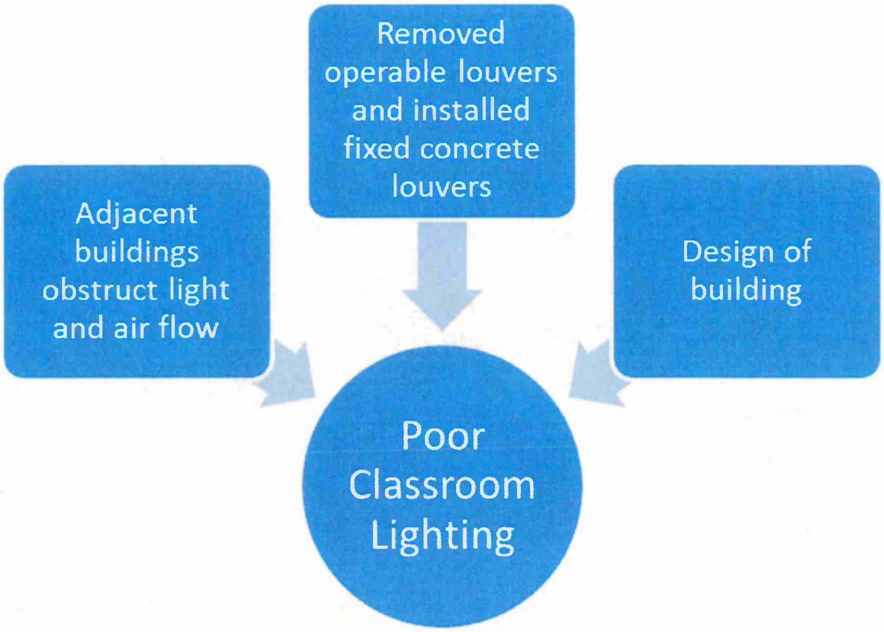

Figure 5.6. Causes of Poor Lighting in Classrooms.

Table 5.6 shows the association between adequate lighting and scores in six academic subjects.

Table 5.6

Association Between Adequate Lighting and Six Academic Scores

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Quality of Light	.216	.495	.422	.468	.289	.447

Note. Kruskal–Wallis Test. $p < .10$.

Comparison of the results showed that two of the six subjects recorded statistically significant results $p < .289$. English Language and Social Studies were the two subjects that were most affected by inadequate lighting, followed by Mathematics, Principles of Accounts (POA), Principles of Business (POB), and Visual Arts $p < .495$. The latter four were less affected by lighting levels. Table 5.7 gives details for all the groups for English Language and Mathematics and Appendix O shows the details for the other four subjects.

Table 5.7

Mean Rank of Five Groups of School Lighting Quality for English Language and Mathematics

Lighting Quality	N	Mean Rank – English Language	Mean Rank - Mathematics
Terrible	1	18.00	45.50
Poor	22	38.11	39.43
Not sure			
Good	57	44.64	42.73
Excellent	3	28.33	45.73
Missing answer	0		
Total	83		

Bathroom adequacy. The Kruskal-Wallis test was run to determine if there were any statistically significant scores among the five groups of schools–terrible, poor, not sure, good and excellent. The analysis revealed that none of the academic scores had any statistically significant differences. Results are shown in Table 5.8.

Table 5.8

Kruskal–Wallis Test for Bathroom Adequacy

Variable	English	Mathematics	POA	POB	Social Studies	Visual Arts
Bathroom Adequacy	.945	.176	.906	.790	.992	.476

Note. Kruskal–Wallis Test. $p < .05$.

Mathematics was noted to be the most responsive subject, while Social Studies was the least responsive to the independent variable addressing the adequacy of bathrooms in schools. The result of this analysis is suggesting that there is little association with bathroom adequacy and student attainment for the six academic subjects. Table 5.9 gives details for all the groups for English Language and Mathematics and Appendix O shows the details for the other four subjects.

Table 5.9

Three Groups of Bathroom Adequacy their Associated Mean Rank for English Language and Mathematics

Bathroom Adequacy	N	Mean Rank - English Language	Mean Rank - Mathematics
Yes, bathroom adequate	48	42.17	45.59
No, bathroom not adequate	32	40.41	35.48
Don't know	3	43.00	39.50
Total	83		

Condition, Maintenance and Cosmetic Variables

A one–way between–groups multivariate analysis of variance was performed to investigate cosmetic variables (see Appendix U). A Wilks' Lambda test was also done for cosmetic variables (see Appendix V). Kruskal-Wallis/Mann-Whitney tests were also done for cosmetic variables (see Appendices L and M).

Window condition. The appearance and condition of classroom windows are good indicators of the effectiveness of the maintenance programme at the school, since windows that are infrequently cleaned will show an unsightly accumulation of dirt, indicating that insufficient maintenance is being done.

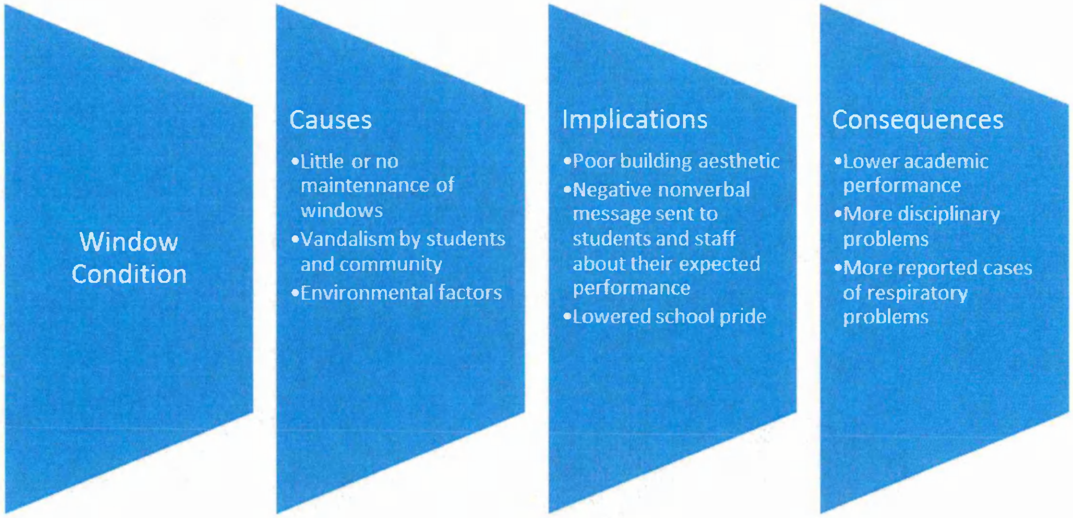

Figure 5.7. Causes of Poor Window Conditions, Implications and Consequences for Students.

Table 5.10 shows the association between the condition of windows and six academic scores; four of the six subjects recorded statistically significant results $p < .093$.

Table 5.10

Kruskal–Wallis Test for Window Condition of Classroom

Variable	English	Mathematics	POA	POB	Social Studies	Visual Arts
Window Condition	.048	.017	.093	.022	.444	.419

Note. Kruskal–Wallis Test. $p < .10$.

Social Studies and Visual Arts were the two subjects that recorded the least amount of association and were the two subjects that were least affected by the conditions of windows. As the condition of the windows deteriorates the academic score tends to decrease. The four subjects that were most sensitive to the condition of windows were English Language, Mathematics, Principles of Accounts (POA) and Principles of Business (POB). Table 5.11 gives details on window condition for English Language and Mathematics.

Table 5.11

Five Groups of School Window Conditions and Their Mean Rank for English Language and Mathematics

Window Condition	N	Mean Rank – English Language	Mean Rank - Mathematics
Terrible condition	2	32.00	17.00
Poor condition	15	31.97	30.27
Not sure	2	23.00	19.25
Good condition	61	43.80	44.88
Excellent condition	1	60.00	57.00
Missing answer	2		
Total	83		

English Language recorded a mean rank of 32.00 to 60.00 for windows that were in terrible condition to those in excellent conditions. Similarly, Mathematics recorded mean of 17 to 57.00 respectively (Kruskal–Wallis test, $p < .10$). Appendix O shows the mean rank for the other four (4) academic subjects.

Site visits revealed that the conditions of school windows in depressed communities are generally poor, especially those made from aluminium. Many windows had missing blades caused by vandalism, lack of maintenance and deterioration due to the build-up of dust and infrequent cleaning. (The Mann–Whitney test revealed that the six academic subjects and the categories, bad and good conditions, recorded statistical significant results.) The findings showed that when the condition of the windows deteriorates, academic scores decline.

The condition of the windows is a visible factor which is obvious from within or from the exterior of a building. The external appearance of a school gives an indication of principals', teachers' and the community's expectations. Students could possibly get the impression that much is not expected of them, thus contributing to the low academic attainment. Researchers argue that when the aesthetic of a building is not pleasing, students get the feeling that the educational system doesn't take their learning seriously. Others argue that it results in increased vandalism (Cash, 1993). Site visits by the researcher also revealed cases where alterations and modifications were done to some school windows, most notably that aluminium operable windows were removed and replaced with fixed concrete louvers. While it is understood that steps must be taken by students and community members to reduce vandalism, serious consideration should also be given to the fact that fixed concrete louver windows have many disadvantages that could affect the comfort level of students and teachers. The concrete louvers and breeze blocks significantly reduce the amount of light and fresh air entering the classrooms and at the same time they allow water in the classroom, thus causing students to be shifting from one side to the other to avoid being wet when it rains heavily. This situation lessens contact time between teacher and student and lessens learning and teaching time as a result of this deficiency in the facility.

The effectiveness of a building maintenance plan can be measured by the conditions of windows. Windows that are dysfunctional having missing blades and operators, and having corroding and peeling paint, reduce the functionality of a building. Missing blades allow rain or dust into classroom spaces, and missing operators keep windows shut or open, reducing their response to frequent changes in outdoor climatic conditions. Rusting and corroding windows significantly affect the aesthetic appearance of a building.

Respondents were asked to give an assessment of the condition of the windows based on their general appearance. Approximately 21%of the respondents of the questionnaire reported that the condition of windows ranged from terrible to bad, while 76.5% reported that the window condition ranged from good to excellent. This finding indicates that most windows in Jamaican schools were in good condition. However, this revelation from the questionnaire is not consistent with the researcher's site visits as most of the windows were observed to be in bad condition. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts (POA), Principles of Business (POB), Social Studies and Visual Arts. The independent variable was window condition. A preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance, covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the seven age groups on the combined dependent variables, $F(30, 42) = 2.36$, $p = .005$: Wilk's Lambda $= .019$: partial eta square .547.

Classroom temperature. Seventy-point-seven percent (70.7%) of the respondents from the questionnaire reported that temperature in the classrooms was intolerable and only 13.4% reported that the temperature was good. One could therefore infer that most of the students at the secondary level in the Jamaican education system are forced to learn in classrooms where the temperatures of the classrooms are not comfortable. Site visits also revealed that some of the classrooms did not have ceiling beds, allowing direct heat from the sun to penetrate the classrooms, especially when the roof is made from zinc sheeting which allows for rapid daytime heating. Figure 5.8 illustrates some of the causes of intolerable temperature in classrooms.

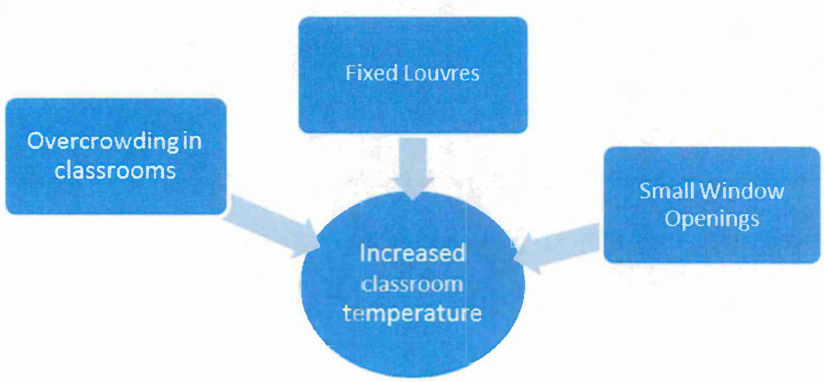

Figure 5.8. Causes of Intolerable Temperature in Classrooms.

The problem of high heat was made more severe when concrete louvers and inoperable windows failed to provide adequate air exchange or cross ventilation. However when respondents were asked to rate the temperature of classrooms, analyses conducted to determine if the academic scores were significantly different across different groups showed that none of the subjects showed significantly different academic attainment as temperature changed. This is shown in Table 5.12 which highlights the association of the independent variable, temperature of classroom and six academic subjects after the Kruskal–Wallis test was run.

Table 5.12

Kruskal–Wallis Test for Temperature of Classroom

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Temp. of Classroom	.129	.154	.195	.420	.236	.878

Note. Kruskal–Wallis Test. $p < .05$.

The Kruskal-Wallis test on this element of building design does not support the expected results that poor classroom temperature would affect academic score based on the observed state of the facilities. Earthman (2004) noted that the temperature of a classroom is one of the most important individual elements that account for improved student's performance. However the examination of the mean rankings for English Language and Mathematics shown in Table 5.13 indicate that, as the classroom temperature moves from unbearably hot, to cool, the mean ranking moves from 31.05 to 46.00 and 27.80 to 44.00 for English Language and Mathematics respectively. So from mean rankings, site visits, and simple ratio, one can infer from these results that as the classroom temperature becomes intolerable the academic scores suffer. Appendix O shows the mean rank and median for the other four academic subjects.

Table 5.13

Five Groups of School Classroom Temperature and their Associated Mean Rank for English Language and Mathematics

Temperature	N	Mean Rank – English Language	Mean Rank - Mathematics
Unbearably hot	10	31.05	27.80
Hot sometimes	58	40.46	41.75
Not sure	2	73.25	69.00
Hot most times	11	50.32	47.41
Cool all the time	1	46.00	44.00
Missing answer	1		
Total	83		

Painting schedule. Ninety- four percent of the school populations have painting done between 8 years and 15 years. The highest painting frequency was done to walkways, corridors, bathroom walls and walls along staircases i.e. common areas. None of the schools recorded painting frequency beyond 15 years. Examination of the mean rankings for English Language and Mathematics indicated that there were marginal differences between the two groups of frequencies, those painted less often, in less than eight years and those painted more often than in every five years. Table 5.14 shows the association between school building painting schedule and six academic scores.

Table 5.14

Kruskal–Wallis Test for Painting Schedule

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Painting schedule	.733	.836	.826	.678	.689	.533

Note. Kruskal–Wallis Test. $p < .05$

Table 5.15 shows the three categories of independent variables that were assessed and the mean rankings for English Language and Mathematics; the results for the other four subjects are included in Appendix O.

Table 5.15

Three Groups of School Painting Schedule and their Associated Mean Rank for English Language and Mathematics

Painting Schedule	N	Mean Rank - English Language	Mean Rank - Mathematics
Over 15 years			
Between 8 and 15 years	3	37.33	44.83
Less than 8 years	80	42.18	41.89
Total	83		

Further analysis of the questionnaire suggested that the frequency of paintings were too far apart; eight years was a considerable length of time between paintings. Regrettably this was not picked up in the pilot testing. While this frequency could be considered acceptable for high level external walls, this frequency is not suitable for internal walls corridors and walkways. Notwithstanding, schools with less frequent painting schedules for walls had higher academic scores for Mathematics, but the inverse was true for English Language. This is shown in Table 5.15.

Colour of walls. Walls were painted in a wide variety of colours. Principals reported that 51.8% of the schools were painted in pastel colours, 8.4% painted in white, 2.4% painted in dark colours, and 26.5% were painted in other colours. Comparisons of the six academic subjects shown in Table 5.16 showed that student scores for Principles of Accounts (POA) and English Language were the least responsive to the colour of classroom walls whilst Mathematics and Visual Arts were the most responsive. Table 5.16 shows that none of the subjects were statistically significant, when comparisons were made among the various groups.

Table 5.16

Kruskal–Wallis Test for Colour of Classroom Wall

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Colour of classroom wall	.788	.381	.966	.544	.416	.345

Note. Kruskal–Wallis Test. $p < .05$

Examination of the mean rankings indicated that for English Language and Mathematics, mean rankings of 25.00 to 42.66 and 19.00 to 39.84 for English Language and Mathematics respectively justified the findings and is shown in Table 5.17. Appendix O gives the details for the other four subjects.

Table 5.17

Four Groups of School Wall Colour and their Associated Mean Rank for English Language and Mathematics

Wall Colour	N	Mean Rank - English Language	Mean Rank - Mathematics
Dark colours	2	25.00	19.00
White	7	43.79	37.93
Pastel colours	43	42.02	45.29
Other	31	42.66	39.84
Missing answer			
Total	83		

The Kruskal-Wallis test was run to determine if there were any statistically significant score among four groups of schools - those with dark, white, pastel and any other colour not specified (see Table 5.17). The analysis revealed that none of the academic scores had significant results. However dark colours showed lower mean ranking for English and Mathematics than pastels and other colours. The findings of the thesis are consistent with that of Bullock (2007) who found that there was no statistical difference between white or pastel colour when analysis was conducted with English Language, Mathematics and Science, whereas Maxwell's (1999) study found that children thought colour was important.

Condition of internal walls. Seventy-eight percent (78%) of the respondents from the questionnaire reported that their internal walls were in good condition and only 13.3% reported that their walls were not in good condition. The Kruskall-Wallis test results revealed that Mathematics scores recorded statistically significant results when comparisons were made with good and bad internal wall conditions. English Language, Principles of Business (POB), Principles of Accounts (POA), Social Studies, and Visual Arts did not show any statistically significant differences. Table 5.18 shows the association between condition of internal walls and students test scores in the respective subject areas, Visual Arts being the most responsive. With the exception of the findings for Mathematics, the findings from this research were consistent with that of Bullock (2007). Bullock's work did not find English Language, Mathematics and Science to be statistically significant.

Table 5.18

Kruskal–Wallis Test Condition of Internal Wall

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Condition Interior Wall	.566	.506	.479	.559	.881	.353

Note. Kruskal–Wallis Test. $p < .05$.

Examination of the mean rankings for English Language and Mathematics indicated that, as the condition of the school's internal walls moved from terrible to excellent the mean rank scores moves from 23.00 to 37.70 and 15.00 to 37.00 for English Language and Mathematics respectively (see Table 5.19; Appendix O gives the details for the other four subjects). These results indicate that as the classroom internal walls worsen the academic scores suffer. This may be attributed similarly to the poor window condition, which indicates that as the window conditions worsen students become less interested in school, possibly due to the perception of lowered expectations of both students and staff. While there were no statistically different scores for the six subjects, academic achievements were different.

Table 5.19

Five Groups of School Internal Wall Condition and their Associated Mean Rank for English Language and Mathematics

Internal Wall Condition	N	Mean Rank - English Language	Mean Rank - Mathematics
Terrible condition	1	23.00	15.00
Poor condition	11	33.86	34.59
Not sure	1	63.00	61.00
Good condition	64	43.06	43.15
Excellent condition	5	37.70	37.00
Missing answer	1		
Total	83		

Condition of external walls. Seventy- eight per cent of the respondents from the questionnaire reported that their external walls were in good condition and only 13.3% reported that their walls were in bad condition; both internal and external walls reported similar ratings. Site observations revealed that at times external walls were not painted even though the internal walls were be painted, especially external upper floors. Kruskal-Wallis tests revealed that none of the scores recorded statistically significant results when comparisons were made with good and bad external wall conditions (see Table 5.20).

Table 5.20

Kruskal–Wallis Test for Condition of External Wall

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Condition of Exterior Wall	.714	.803	.866	.820	.912	.652

Note. Kruskal–Wallis Test. $p < .05$.

The findings are consistent with the findings of Bullock (2007) who found that there are no statistically significant scores for English language, Mathematics and Science (0.82, 0.53, and 0.71 respectively) with external wall condition. Table 5.21 shows mean rankings for English and Mathematics but no trend could be discerned. Appendix O gives the details for the other four subjects.

Table 5.21

Five Groups of School External Wall Condition and their Associated Mean Rank for English Language and Mathematics

External Wall Condition	N	Mean Rank - English Language	Mean Rank - Mathematics
Terrible condition	1	15	21
Poor condition	11	34.59	44.91
Not sure	1	61.00	65
Good condition	64	43.15	41.9
Excellent condition	5	37	28.9
Missing answer	1	0	0
Total	83		

Condition of ceiling. Eighty-one point nine percent reported that the ceilings of classrooms were in good condition and only 12% reported that ceiling conditions were poor.

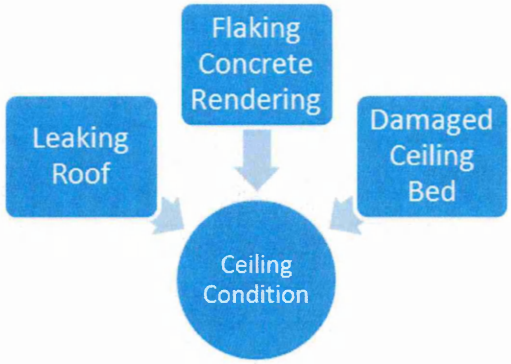

Figure 5.9. Factors Affecting or Impacting Ceiling Condition in Classrooms.

Site visits revealed that ceiling conditions are generally good, especially when there are no roof leaks and when ceilings are present; some classrooms have no ceilings. Table 5.22 shows the association between condition of ceiling and students test scores in the respective subject areas but there is no statistical significance for any of the subjects.

Table 5.22

Kruskal–Wallis Test for Condition of Ceiling

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Condition of Ceiling	.696	.748	.619	.796	.796	.701

Note. Kruskal–Wallis Test. p < .05.

Examination of the mean rankings for English Language and Mathematics indicated that as the condition of school ceilings moves from terrible condition to excellent condition the mean rank scores moves from 22.50 to 42.00 and 26.75 to 42.00 for English Language and Mathematics respectively. The researcher infer from these results that as the classroom ceilings deteriorate so does the academic scores. Appendix O gives the details for all six subjects.

Classroom cleaning schedule. Sixty-five- point-one percent (65.1%) of the respondents reported that their classrooms are cleaned once per day, while 27.7% reported that classrooms were cleaned twice per day. Site visits revealed that most classrooms were not sufficiently cleaned and school yards were usually unkempt when cleaning is not done regularly. Examination of the various subjects showed that Mathematics was the most sensitive to cleaning schedule, meaning that infrequent cleaning of classrooms tended to give low academic scores with Mathematics being the most responsive. This was followed by English Language and Social Studies. Visual Arts was the least responsive to cleaning schedule of classrooms (see Table 5.23). Lanham (1999) found that the frequency of floor sweeping is related to student's achievement. Classrooms that are not cleaned on a regular basis created discomfort for students and teachers and exposes them to possible health risks and safety hazards. Debris, discarded building materials, obsolete equipment and appliances as well as broken furniture act as breeding grounds for vermin and vectors of disease. Recently high levels of rat infestation at a prominent high school resulted in closure of the school for three days. The school re-opened when the school yard was rid of debris and waste. The closure of the school in this manner reduces the teaching time and thus negatively affects the learning process.

Table 5.23

Kruskal–Wallis Test for Classroom Cleaning Schedule

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Classroom Cleaning Schedule	.237	.160	.436	.589	.239	.762

Note. Kruskal–Wallis Test. $p < .05$.

Examination of the mean rankings for English Language indicates that as the cleaning frequency of classroom decreases the academic scores tend to increase. In the case of Mathematics mean ranking moved from 35.75 to 44.47 (see Table 5.24). The researcher infers that as the frequency of cleanings increases academic scores suffer. This result is surprising, as one would believe that the more frequently classrooms are cleaned it would create a more comfortable environment for learning resulting in higher test scores, instead of the inverse relationship. However, one has to take in to consideration other intervening factors. Appendix O gives the details for the other four subjects.

Table 5.24

Five Groups of School Cleaning Schedules and their Associated Mean Rank for English and Mathematics

Dependent Variables	N	Mean Rank - English Language	Mean Rank - Mathematics
Cleaned three times daily	4	30.88	35.75
Cleaned twice a day	23	36.46	34.26
Cleaned once a day	54	44.30	44.47
Cleaned every week			
Other, please specify	1	49.00	56.00
Missing			
Total	83		

This item looked at the frequency at which classrooms are cleaned ranging from three times daily to at least cleaned once per week. When a Kruskal-Wallis test was conducted it revealed that Mathematics, English Language, Principles of Accounts (POA), Principles of Business (POB), Social Studies and Visual Arts were not statistically significant when comparisons were made between schools that were cleaned frequently and those that were cleaned infrequently. In Bullock's (2007) work, Mathematics was also the only subject that showed statistically significant results; that is .028. This finding was similar in this study; showing a statistically significant level (see Table 5.23).

Condition of bathroom facility. This factor was discussed in chapter four.

Table 5.25

Kruskal–Wallis Test for Bathroom Cleaning Schedule

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Bathroom Adequacy	.945	.176	.906	.790	.992	.476

Note. Kruskal–Wallis Test. $p < .05$.

Condition of grounds. The condition of school yards has marked variability. Principals reported that 6% of the schools have no landscaping and have sidewalks that are unattractive, 21.7% reporting that there is no landscaping or sidewalks, a situation considered unattractive to the community, yet 65.1% of principals reported that landscaping is attractive and well maintained. The first impression visitors have of the grounds can affect enrolment of faculty and staff, and the attitudes of visitors and benefactors (Peterman, 1997).

In analyzing data relating to the landscaping, sidewalks, and the overall attractiveness of the school grounds, Kruskal-Wallis tests were run to determine if there were any statistically significant scores among the three groups of schools based on the condition of the school grounds: those that were unattractive, and those that were acceptable, and those that were excellent. The analysis revealed that schools with better landscaped areas were associated with better academic scores. Mean rank ranged from 25.20 to 44.67 and 34.10 to 43.54 for English Language and Mathematics respectively and is captured in Table 5.26. This finding is consistent with the findings of Bullock (2007) who did not find any statistically significant difference in academic scores for English Language, Mathematics and Science. Appendix O gives the details for the other four subjects.

Table 5.26

Three Groups of Landscaping Condition and their Associated Mean Rank for English Language and Mathematics

Dependent Variables	N	Mean Rank - English Language	Mean Rank - Mathematics
Landscape and sidewalk present	5	25.20	34.10
No landscape and sidewalk present	18	35.64	36.86
Landscape and sidewalk are attractive	59	44.67	43.54
Missing answer	1		
Total	83		

Of the six academic subjects English Language and Principles of Business (POB) exhibited statistically significant results. This suggests that as the principals of school give good ratings to the school grounds the academic scores tend to be higher. Table 5.27 shows the findings. In contrast, Cash (1993) did not find any relationship between school grounds and students attainment.

Table 5.27

Kruskal–Wallis Test for Condition of School Grounds

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Condition of School Grounds	.107	.449	.559	.049*	.192	.749

Note. Kruskal–Wallis Test. $p < .05$.

Condition of furniture. Condition of furniture showed consistent statistical significance with four of the six subjects: English Language, Mathematics, Principles of Business (POB) and Social Studies. School principals thought at least half of the rooms had furnishings with some minor facial scars. Sixty-seven-point-five percent of the principals reported that furniture was sound and looked satisfactory; however 13.3% reported that most rooms have furniture that is either scared or functionally damaged. Principles of Business (POB) and Visual Arts were the least responsive to condition of classroom furniture at 0.216 and 0.324 respectively as shown in Table 5.28.

Table 5.28

Kruskal–Wallis Test for Condition of Classroom Furniture

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Condition of Classroom Furniture	.011*	.039*	.216	.150	.060*	.324

Note. Kruskal–Wallis Test. $p < .05$.

Table 5.28 shows the statistically significant subjects, when comparisons were made among the various groups. Examination of the mean ranking suggests that as the furniture condition deteriorates academic scores of the students tend to suffer. Mean rankings of 25.73 to 54.21 and 30.91 to 54.04 for English and Mathematics respectively justify the findings as seen in Table 5.29. Appendix O gives the details for the other four subjects.

Table 5.29

Three Groups of Furniture Condition and their Associated Mean Rank for English Language and Mathematics

Dependent Variables	N	Mean Rank – English Language	Mean Rank - Mathematics
Furniture is either scarred or functionally damaged	11	25.73	30.91
Half of the rooms have furniture with minor facial scars	56	40.70	39.72
Furniture sound and attractive	14	54.21	54.04
Missing answer	2		
Total	83		

A Kruskal-Wallis test was run to determine if there was any statistically significant difference in scores among three groups of schools based on the condition of the furniture in their classrooms; those that are scarred or functionally damaged, those with minor facial scars but which are functionally sound and look satisfactory and those that are functionally sound and attractive. The analysis revealed that English Language, Principles of Business (POB), and Social Studies were the only subjects that revealed statistically different scores. Cash (1993) reported that furniture condition was related to higher mean scores.

Presence of graffiti. Presence of graffiti showed consistent statistical significance with four of the six subjects: English Language, Mathematics, Principles of Business (POB) and Social Studies. School principals also reported that graffiti was found in 23% of their schools. The presence of graffiti can be an indication of disciplinary problems; the placing of marks on walls can result in disciplinary action taken against the students. It also causes the walls to be unsightly and can be an indication of the existence of gangs in the schools.

Table 5.30

Kruskal–Wallis Test for Presence of Graffiti

Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
Presence of Graffiti	.047*	.120	.296	.042*	.036*	.468

Note. Kruskal–Wallis Test. p < .05.

Table 5.31 shows the statistically significant subjects, when comparisons were made among the various groups. Examination of the mean rankings suggests that as the presence of graffiti becomes more prevalent the academic scores of the students tend to suffer. There was a general increase in mean rankings of 30.55 to 80.00 and 26.66 to 73.50 for English and Mathematics respectively (see Table 5.31). The findings supports the findings of Al-Enezi (2002) who noted that graffiti and roof leaks are the main predictors of physical aspects of a building's condition. Price, Clark, Holland, Emerton, and Wolstenholme (2009) were told by a head teacher and the building manager that a zero tolerance approach to graffiti and effective self-policing restored pride in users of a facility. The mean ranking for the other four subjects are detailed in Appendix O.

Table 5.31

Four Groups of Graffiti Schools with their Associated Mean Rank for English Language and Mathematics

Dependent Variables	N	Mean Rank – English Language	Mean Rank - Mathematics
Graffiti is commonly found	19	30.55	26.66
Graffiti is sometimes found	45	45.57	45.06
Graffiti is rarely found	17	40.71	46.79
Graffiti is never found	1	80.00	73.50
Missing answer			
Total	83		

A Mann-Whitney test revealed that none of the scores recorded statistically significant results when comparisons were made with the frequent and infrequent presence of graffiti for English Language, Mathematics, Principles of Business (POB), Principles of Accounts (POA), Social Studies and Visual Arts scores. The finding is consistent with the finding of Bullock (2007) who reported significant levels of 0.11, 0.48 and 0.176 for English Language, Mathematics and Science respectively.

Ranking of Variables According to Subject

Ranking of variables affecting English Language. Comparisons revealed that 39% (9) of the independent variables showed significant results; specifically six of the independent variables were statistically significant at $p < .06$ and the other three were significant at $p < .131$. The age of the facility was the most significant, $p < .000$ while the colour of walls was the least significant, $p < .788$. Table 5.32shows the statistically significant independent variables used in the thesis and their comparison with English Language. In detail, the results show that building age, presence of workshops, condition of classroom furniture, presence of graffiti, vehicular traffic and bathroom condition all recorded statistically significant results at the $p < .01$., while condition of school grounds, temperature of classroom and presence of construction activities all showed statistically significant results at the $p < .13$ levels indicating strong association between building condition and English Language.

Table 5.32

Results from Multivariate Analysis for English Language

Variables	English Language
Building age	.000**
Wood workshop	.002*
Condition of classroom furniture	.011*
Presence of graffiti	.047*
Vehicular traffic	.061
Bathroom condition	.100
Condition of school grounds	.107
Temperature of classroom	.129
Construction activities	.131
Quality of light	.216
Classroom cleaning schedule	.237
Window condition	.268
Proximity of railway	.299
Community complex	.302
Proximity of airport	.350
Bathroom cleaning schedule	.369
Condition of interior wall	.566
Window presence	.602
Condition of ceiling	.696
Condition of exterior wall	.714
Painting schedule	.733
Colour of classroom wall	.788
Bathroom adequacy	.945

Note. $p < .05$.

Ranking of variables affecting Mathematics. Table 5.33 shows the statistical significance of all the independent variables used in this thesis and their comparison with Mathematics. Mathematics tied with English to record the largest amount of significant independent variables (6), suggesting that English and Mathematics are the subjects most associated with the condition of the buildings.

Table 5.33

Results from Multivariate Analysis for Mathematics

Variables	Mathematics
Building age	.000**
Wood workshop	.015*
Condition of classroom furniture	.039*
Construction activities	.049*
Vehicular traffic	.053
Window condition	.060
Presence of graffiti	.120
Temperature of classroom	.154
Classroom cleaning schedule	.160
Bathroom condition	.172
Bathroom adequacy	.176
Proximity of railway	.181
Community complex	.343
Proximity of airport	.373
Colour of classroom wall	.381
Condition of school grounds	.449
Quality of light	.495
Condition of interior wall	.506
Window presence	.519
Bathroom cleaning schedule	.657
Condition of ceiling	.748
Condition of exterior wall	.803
Painting schedule	.836

Note. $p < .05$.

Ranking of variables affecting Principles of Accounts. A comparison revealed that 22% (5) of the independent variables showed significant results, specifically three of the independent variables were statistically significant at $p < .06$ and the other two were significant at $p < .195$. Age of the facility was the most significant, $p < .000$, while colour of walls was the least significant $p < .966$. Table 5.34 shows the statistically significant variables used in this thesis and their comparison with Principles of Accounts (POA), which recorded the second to last, most significant independent variables of the six (6) academic subjects.

Table 5.34

Results from Multivariate Analysis for Principles of Accounts

Variables	POA
Building age	.000**
Wood workshop	.006*
Construction activities	.059
Window presence	.185
Temperature of classroom	.195
Condition of classroom furniture	.216
Presence of graffiti	.296
Window condition	.391
Bathroom cleaning schedule	.393
Quality of light	.422
Classroom cleaning schedule	.436
Proximity of airport	.440
Condition of interior wall	.479
Proximity of railway	.495
Condition of school grounds	.559
Community complex	.596
Bathroom condition	.606
Condition of ceiling	.619
Painting schedule	.826
Condition of exterior wall	.866
Bathroom adequacy	.906
Vehicular traffic	.917
Colour of classroom wall	.966

Note. $p < .05$.

Ranking of variables affecting Principles of Business. Comparisons revealed that 35% (8) of the independent variables showed significant results, specifically five of the independent variables were statistically significant at $p < .05$ and the other three were significant at $p < .15$. Age of the facility was the most significant at $p < .000$ while the condition of external walls was the least significant at $p < .820$. Table 5.35 shows the statistically significant independent variables used in this thesis and their comparison with Principles of Business (POB).

Table 5.35

Results from Multivariate Analysis for Principles of Business

Variables	POB
Building age	.000**
Wood workshop	.003*
Presence of graffiti	.042*
Construction activities	.045*
Condition of school grounds	.049*
Bathroom condition	.147
Window condition	.148
Condition of classroom furniture	.150
Bathroom cleaning schedule	.203
Vehicular traffic	.345
Proximity of railway	.381
Window presence	.392
Temperature of classroom	.420
Proximity of airport	.440
Quality of light	.468
Colour of classroom wall	.544
Condition of interior wall	.559
Classroom cleaning schedule	.589
Painting schedule	.678
Community complex	.727
Bathroom adequacy	.790
Condition of ceiling	.796
Condition of exterior wall	.820

Note. $p < .05$.

Ranking of variables affecting Social Studies. Comparisons revealed that 43% (9) of the independent variables showed significant results; specifically seven of the independent variables were statistically significant at $p < .081$ and the other two were significant at $p < .192$. Age of the facility was the most significant, $p < .015$, bathroom adequacy was the least significant, $p < .992$. Table 5.36 shows the statistical significance of all the independent variables used in this thesis and their comparison with Social Studies, which recorded the third to last most significant independent variables of the six academic subjects.

Table 5.36

Results from Multivariate Analysis for Social Studies

Variables	Social Studies
Building age	.015*
Woodwork shop	.016*
Presence of graffiti	.036*
Proximity of railway	.045*
Construction activities	.051*
Condition of classroom furniture	.060*
Community complex	.081
Vehicular traffic	.149
Condition of school grounds	.192
Temperature of classroom	.236
Classroom cleaning schedule	.239
Quality of light	.289
Bathroom cleaning schedule	.412
Colour of classroom wall	.416
Bathroom condition	.459
Window condition	.630
Painting schedule	.689
Window presence	.717
Condition of ceiling	.796
Condition of interior wall	.881
Condition of exterior wall	.912
Proximity of airport	.927
Bathroom adequacy	.992

Note. $p < .05$.

Ranking of variables affecting Visual Arts. Comparisons revealed that 17% (4) of the independent variables showed significant results; specifically two of the independent variables were statistically significant at $p < .047$ and the other two were significant at $p < .173$. Visual Arts is the only subject that is not statistically significant with age, suggesting that the age of the facility has the least association with students' academic scores for the subject. In fact the opposite was found to be true: aged has the least significant results, $p < .938$. Table 5.37 showing the statistically significant variables used in this thesis and their comparison with Visual Arts.

Table 5.37

Results from Multivariate Analysis for Visual Arts

Variables	Visual Arts
Woodwork shop	.012*
Community complex	.047*
Window condition	.152
Proximity of railway	.173
Condition of classroom furniture	.324
Window presence	.331
Bathroom cleaning schedule	.342
Colour of classroom wall	.345
Condition of interior wall	.353
Construction activities	.419
Quality of light	.447
Presence of graffiti	.468
Bathroom adequacy	.476
Painting schedule	.533
Bathroom condition	.562
Vehicular traffic	.639
Condition of exterior wall	.652
Condition of ceiling	.701
Condition of school grounds	.749
Classroom cleaning schedule	.762
Temperature of classroom	.878
Proximity of airport	.901
Building age	.938

Note. $p < .05$.

Structurally Independent Variables

Table 5.38 shows all the structural independent variables that were used in this thesis. As can be seen none of the variables has any significant association with Visual Arts. The most significant variable across the table was building age. Window presence and bathroom adequacy showed less significance than those previously mentioned.

Table 5.38

Results from Kruskal–Wallis Test with All Structural Variables

Number of significant variables at <.1 p= < 0.1	Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
4	Building age	.000**	.000**	.000**	.000**	.015*	.938
0	Window presence	.602	.519	.185	.392	.717	.331
0	Adequacy of lighting	.216	.495	.422	.468	.289	.447
0	Bathroom adequacy	.945	.176	.906	.790	.992	.476

Note. Kruskal–Wallis Test. $p < .05$.

Cosmetic Independent Variables

There were four of fourteen cosmetic variables that showed significance. These were condition of classroom furniture (for 3 subjects–English, Mathematics and Social Studies), presence of graffiti (for 3 subjects–English, Principles of Business and Social Studies), window condition (for 1 subject--Mathematics) and condition of the grounds (for 1 subject--Principles of Business). Table 5.39 records the independent variables of all the cosmetic variables, which recorded a lower percentage of independent variables tending to affect academic scores, except Principles of Business (POB) and Visual Arts at 50% and 10 % respectively.

Table 5.39

Results from Kruskal–Wallis Test with All Cosmetic Variables

Number of significant variables at <.1 p=< 0.1	Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
1	Window condition	.268	.060*	.391	.148	.630	.152
0	Temperature of classroom	.129	.154	.195	.420	.236	.878
0	Colour of classroom wall	.788	.381	.966	.544	.416	.345
0	Painting schedule	.733	.836	.826	.678	.689	.533
0	Condition of interior wall	.566	.506	.479	.559	.881	.353
0	Condition of exterior wall	.714	.803	.866	.820	.912	.652
0	Condition of ceiling	.696	.748	.619	.796	.796	.701
0	Classroom cleaning schedule	.237	.160	.436	.589	.239	.762
0	Bathroom condition	.100	.172	.606	.147	.459	.562
0	Bathroom cleaning schedule	.369	.657	.393	.203	.412	.342
3	Condition of classroom furniture	.011*	.039*	.216	.150	.060*	.324
3	Presence of graffiti	.047*	.120	.296	.042*	.036*	.468
1	Condition of school grounds	.107	.449	.559	.049*	.192	.749

Note. Kruskal–Wallis Test. p < .05.

The Mann–Whitney test was used to analyze these independent variables because each variable has two categories and as was established in Table 5.1, non–parametric tests were suitable for these variables. Table 5.40 shows the results of Mann-Whitney tests with noise nuisance variables. Comparisons revealed that proximity of airport to school facilities is the only independent variable that did not record any significant findings, when comparisons were done with the six academic subjects. This was followed by proximity of community complex; which only had two statistically significant academic scores showing significance $p < .081$. The proximity of construction activities had four of the subjects recording statistically significant scores, one at $p < .136$, and four at $p < .058$. Workshops presence recorded the most statistical significance score, with all six subjects recording significance, $p < .015$. One can infer that the presence of workshops, metal or woodwork, has an association with students' academic scores; as the noise activities become more frequent and louder the scores tend to suffer. Table 5.39 shows all the independent variables and the six academic scores.

Table 5.40

Results from Mann–Whitney U Test with Noise Nuisance Variables

Number of significant variables at <.1 p= < 0.1	Variables	English	Mathematics	POA	POB	Social Studies	Visual Arts
	Proximity of airport	.382	.413	.477	.382	.939	.914
2	Vehicular traffic	.061*	.053*	.917	.345	.149	.639
1	Proximity of railway	.339	.212	.529	.413	.035*	.205
4	Construction activities	.136	.048*	.058*	.043*	.049*	.438
6	Wood workshop	.002	.015*	.006*	.003*	.016*	.012*
2	Community complex	.302	.343	.596	.727	.081*	.047*

Note. Mann –Whitney Test. $p < .10$.

Socioeconomic Factors

Discussions with principals during site visits revealed that in some older schools there are strong Past Student Associations, indicating a more established school culture, one that supports high achievement, and a culture of "striving for excellence." These Past Student Associations assist schools financially and enable them to afford more comprehensive maintenance, renovations and improvement to existing buildings. There are cases where these associations have contributed or aided in erecting new buildings on school properties. It has been argued that, over time, buildings become less useful and more costly to incorporate modern teaching methods, particularly new teaching styles which affect the teaching and learning process, especially when maintenance does not take place. Timely and adequate maintenance or renovations can cause buildings to remain functional up to its full useful life or even extend the useful life of buildings which is evident from older buildings still being used for teaching facilities.

In the study by Uline and Tschannen-Moran (2008) it was found that the socioeconomic status of the student body was unrelated to the quality of the school buildings. This could therefore mean that whether students are from a poor background or not it was unrelated to the condition of the school facility. Thus supporting the argument that school facilities should be in an excellent condition in order to give students that live in poor socioeconomic areas an experience–a change of environment when they are at school. It would also lift their personal perspective of the school facility which would serve well to influence the facility at home and in their communities. With this better understanding of facility condition students would become committed alumni.

Established alumni, consisting of engineers, doctors, teachers, accountants and other professionals, may also bridge the gap that may exist in terms of technical advice and guidance in terms of building infrastructure. The technical support system for school infrastructure is inadequate; only one Chief Building Officer and four Building Officers serve the entire stock of over three hundred schools in Jamaica (structured conversation with Chief Building Officer, Ministry of Education—see Appendix W).

Analysis of data combined with discussions with senior personnel in the Ministry of Education, teachers, and school principals and site visits have resulted in the following main findings of thc thesis.

1. Facilities that are in a better condition are associated with better academic performance.
2. Institutional structures to support effective facilities management practices in schools are grossly deficient.
3. Design deficiencies exist in a significant portion of the schools, particularly in precast structures.
4. Schools are not maintained to the same standard.
5. Strategic planning that creates or makes arrangements for the growing population of school children is not utilized (including Financial Planning and Resource Generation).
6. Schools near cane fields, sewage plants, and noise generating areas, whilst not studied in detail, emerged as a problem negatively affecting students' performance.
7. Schools maintained at a higher standard have active support from Past Student Associations or other community groups.

Conversations with principals and Ministry of Education (MOE) officials such as the Chief Architect, Chief Building Officer and Building Officers and a review of the draft "Ministry of Education Planning and Design Standards for School Buildings and General Facilities" and the "School Facilities Maintenance Manual – A Practical Guide for School Administrators" revealed deficiencies in the system that now supports facilities management, including

- a reactive rather than proactive environment;
- slow procurement (the average turnaround time is two to three weeks as at least three committees must give approval for spending even for small contracts);
- lack of suitable software for estimating costs and planning;
- lack of electrical, mechanical and structural expertise in-house;
- lack of suitable funding.

Facilities Management

The Jamaican TFoER (Davis, 2004) in its quest to change the Jamaican learning environment focused its recommendations under four main headings:

1. Governance and management of the education system
2. Curriculum, teaching and learning support
3. Full stakeholder participation in the education system
4. Financing

Facilities Management is not listed as a priority and is therefore not effectively employed within the Jamaican education system. There is no doubt it is a consequence of affordability, but the reluctance to employ sound Facilities Management across the education system also has to do with non-adoption of the concept of perceiving children as clients as well as the non-recognition of the benefits that Facilities Management would offer. Many school facilities leave much to be desired while students underperform. There are gaps concerning the design, construction, implementation, maintenance and staffing of schools. Some schools are little more than concrete or wooden rectangles with tables and chairs in them and are still mirroring and supporting the traditional industrial style teaching. In addition maintenance and planning is poor and the principals (managers) of the schools are often not equipped to deal with facilities issues, as they often have no background in Facilities Management, being classroom teachers promoted to the position of principal.

The Royal Institution of Chartered Surveyors defined "Facilities Management" as the total management of all services that support the core business of an organization. Ashworth and Hogg (2007) believed that the scope of Facilities Management serves many ranges including the provision of a single service at an operational level, which includes maintenance management. Barrett and Baldry (2003) defined Facilities Management as "an integrated approach to maintaining, improving and adapting the buildings of an organization in order to create a stable environment." (p. xi). In spite of the rapid growth of the Facilities Management literature over the last decade, the discipline has been criticized for lacking a rigorous body of research (Nutt, 1999; Price, 2002). Cairns (2003), also argued that much of what is currently held as theory in the Facilities Management field is little more than slogans with some empirical or theoretical foundation and suggested that the discipline must pay more attention to epistemological issues if it is to develop as a true management discipline. The Jamaican TFoER (Davis, 2004) informed that less than desirable environments are provided for some of Jamaican students. Specifically the report said that 20% of the school buildings needed major repairs and a further 38% were in need of minor repairs.

As cited by Lavy and Bilbo (2009) routine and unexpected maintenance demands are bound to arise (Sarja, 2002), and hence every educational organization must proactively develop and implement a facilities maintenance plan to deal with these demands. Studies show that facilities that are in substandard state turn out lower performance results (Cash, 1993). Lavy and Bilbo (2009) also explained that facilities deficiencies affect teaching and learning performance, students and staff health and safety, and day to day operations. Consequently, they believed it is essential for every school to have a plan for effective Facilities Management. They posit that facilities deficiencies result from numerous causes, including extreme environmental conditions and lack of maintenance funding. They further argued that many facilities problems are not due to geographical or social economic factors but the level of training of maintenance staff and management practices. Furthermore, Lavy and Bilbo (2009) posited that even new buildings face age-related issues such as roof leakage, insufficient energy system, and other cosmetic problems that can lead to an uncomfortable indoor climate and high utility bills. In addition to problems relating to new and old buildings, they posited that maintenance planning provides substantial help by providing resourceful information about the facility and the amount of work required.

Lackney (2007) reinforces the need for Facilities Management and suggested that a proactive Facilities Management Programme should be designed during the planning phase of a project to anticipate facility problems, rather than reacting to problems when they occur. The researcher believes that Facilities Management should be an integral part of the school design to ensure long-term and optimal use of the facility. Management of the facility should therefore "include the maintenance and operations of the 'physical plant' - the mechanical, electrical, plumbing, power, security and other building systems as well as custodial and maintenance programs" (Lackney, 2007, p. 1).

Chapter 6

Conclusions and Recommendations

Overall Conclusions

The findings of this thesis confirm variability in school building conditions as hypothesized in chapter three and support the perception of the facilities-related defects identified by the report by the Task Force on Education Reform (Davis, 2004) which has brought into sharp focus the state of the education system's physical space. It reported that schools were poorly maintained, specifically mentioning the poor state of the bathroom facilities and lack of perimeter fencing among many other facility defects. In summary, this thesis confirms that there is a relationship between Jamaican school building conditions and students' academic attainment thus showing that the following hypotheses were not supported i.e. H_1 = There is no difference in student attainment between new schools, average aged schools, and old schools, H_2 = There is no difference in student attainment between schools with differences in cosmetic conditions and H_3 = There is no difference in student attainment between schools with differences in structural design. Particularly, this thesis confirms that there is a relationship between building condition and students' attainment; that there is a relationship between cosmetic variables and students' attainment and that there is a relationship between structural variables and students' attainment. This conclusion supports the findings of much other earlier research which were similar. The association was made with both cosmetic and structural variables; cosmetic variables are more related to maintenance activities and structural variables are related to design. The findings from this research strongly support other research findings in the field, which posited that there is a strong link between building condition and student's academic performance. Specifically, this research demonstrates that students' academic performances tend to improve with the quality of the facility. That is, the findings allow the researcher to conclude that there is a strong correlation between building condition and students' attainment.

The analysis of the data revealed that the Jamaican education system has buildings that are poorly designed and insufficiently maintained and could be negatively affecting student's performance. Specifically, the data showed that building age, window condition, bathroom condition, presence of graffiti, condition of classroom furniture, condition of grounds, temperature of classrooms, and the condition of ceilings all show statistically significant association with the academic achievement of students. Eight of seventeen variables relating to school facilities were statistically significant. Five of the six variables relating to noise generating facility were also statistically significant. This suggests that schools with deficiencies in any of these variables showed lower academic achievement in subjects that students sat at regional level examinations.

Logically, if educational facilities have design defects they will not enhance the productivity of its users. In the Jamaican situation, it seems that most school buildings have satisfied the basic design principles, except precast structures and poorly placed schools located near noisemaking facilities. Earthman et al. (1995) argued that when these basic design considerations are satisfied further improvement does not lead to higher academic achievement. In Jamaica, it is the remodelling, expansion and renovations of older facilities that show little respect for the original architectural considerations.

This thesis joins the few studies that investigated the effect of building conditions on student's attainment and comes to the following conclusions.

- Students that are educated in older buildings perform significantly better than those students that are educated in schools that are younger.

- Students that are in facilities that have better conditions and that give consideration to design elements are associated with higher academic scores for most subjects.
- Schools with better window condition tend to have students with higher academic scores.
- Facilities with higher lighting levels tend to have better academic scores.
- School facilities with temperatures that are uncomfortable tend to have lower academic scores.
- Painting schedule, condition of internal and external walls and ceiling did not show any statistical significant results.
- Student facilities that are in close proximity to heavy vehicular traffic, railways, construction activities, wood and metal workshops, and community complexes, tend to have lower academic scores.
- Facilities with more frequent cleaning schedules tend to have higher academic scores, particularly in Mathematics.
- Facilities with a higher bathroom to student ratio tend to have higher academic scores, particularly in Mathematics.
- Schools with better bathroom conditions tend to have higher academic scores especially in Mathematics and English.
- Facilities with more graffiti tend to have lower academic scores, especially in English Language, Mathematics and Principles of Business (POB).
- Schools with better classroom furniture tend to exhibit better academic scores, especially English Language, Mathematics, Principles of Business (POB) and Social Studies.

- Schools with better grounds exhibit better academic scores.
- The colour in which schools are painted does not have a significant impact on students' academic scores.
- Students educated in facilities that are not of precast construction tend to have higher academic outcomes.

Comparisons with Other Studies Using the Cash Model

Cash (2003), investigated the relationship between the condition of school facilities and student achievement and behavior by administering a questionnaire (CAPE). The population she used consisted of 47 small, rural high schools in Virginia, USA (secondary schools used as the population). Similar to this study, in Cash's (1993) study all achievement scores were adjusted for socioeconomic status and results were analyzed using covariance, correlations and regression analysis. A similar conclusion was made that students' scores were higher in schools with better building condition. Cash found that cosmetic building conditions appeared to impact students' achievement more that structural building conditions. In this thesis it was found that elements such as building age were associated with the impact of building condition on students' scores and cosmetic variables i.e. cosmetics factors such as window condition, condition of classroom furniture, presence of graffiti and condition of school grounds were found to be significant. In Cash's research the significant factors that positively related to students' achievement were varying climate control, locker and graffiti.

Lanham (1999) used a population of 197 randomly selected elementary schools in Virginia. Lanham modified the CAPE to suit the secondary school environment and as in this thesis the CAPE results were verified by school principals. Stepwise regression and a multiple regression were used to analyze the data in SPSS. Lanham found that improving certain building conditions, specifically air conditioning, noise control, building cleanliness and Internet access can improve student achievement which this research also found significant. In addition he found ceiling type, site size, connection to a wide area network, room structure, overall maintenance, floor type and sweeping and mopping frequency to be significant.

In the first study conducted outside the United Stated based on Cash's Model, Al–Enezi (2002) investigated the possible relationship between the conditions of high school buildings and student achievement in Kuwait. His population was 56 high schools (28 male and 28 female). In Kuwait public schools are segregated by gender. Privately funded schools may be co-ed. It was important therefore for Al-Enezi to compare similarities and differences between genders. As with Lanham and also in this thesis, school principals were used to validate the questionnaire but they did not participate in the research. Pearson analysis, multiple regression and stepwise multiple regression and one-way and two-way factorial design were used. ANOVA, Pearson R, T-test and multiple regression were the main tools for the data analysis. Al–Enezi found that building conditions have a significant effect on test scores in science and that graffiti and roof leaks were the main predictors for student achievement. The research noted that results varied by gender and by academic study with building conditions having less impact on boys than girls. The environment in which Al-Enezi conducted his study differed from the Jamaican environment in several important aspects. The Kuwaiti educational system is wealthier, being funded by the Kuwati government which has invested large sums of money in education in contrast to Jamaica which struggles to find the funding to invest in social programs like education. Kuwait also has a stock of school buildings all with similar physical features such as windows, concrete ceilings and fluorescence lighting. In Jamaica there is variation in design of the stock of buildings.

A Modified Cash Model

The CAPE has been successful in facilitating research in both developed and developing countries and was able to identify the physical conditions of building that may be hindering or aiding the performance of students. It facilitated the use of various statistical tools to provide information that is useful for school administrators. The Cash Model is extremely important and has served its purpose of advancing research. The CAPE therefore needs to be credited for its usefulness in that it was able to be modified to explore factors that were suspected to be hindering the performance of students in the Jamaican education system. The CAPE has been successful in establishing that a link exists between school facility condition and students' performance. The main elements of the Cash Model are leadership, financial and technical capabilities, building condition (cosmetic and structural), attitudes of students, parents, faculty and community and student attainment. The technical assessment that is provided by the CAPE is instrumental in generating recommendations for school administrators. The researcher proposed a modified Cash Model as shown in Figure 6.1 in order to make the instrument more suitable for the Jamaican context. As one would imagine, with Jamaica being a developing country and with the United States of America being a developed country, there would be a difference in the amount of capital available for school facilities. This difference would therefore be reflected in the condition of the facilities and the modification to the CAPE addresses this difference.

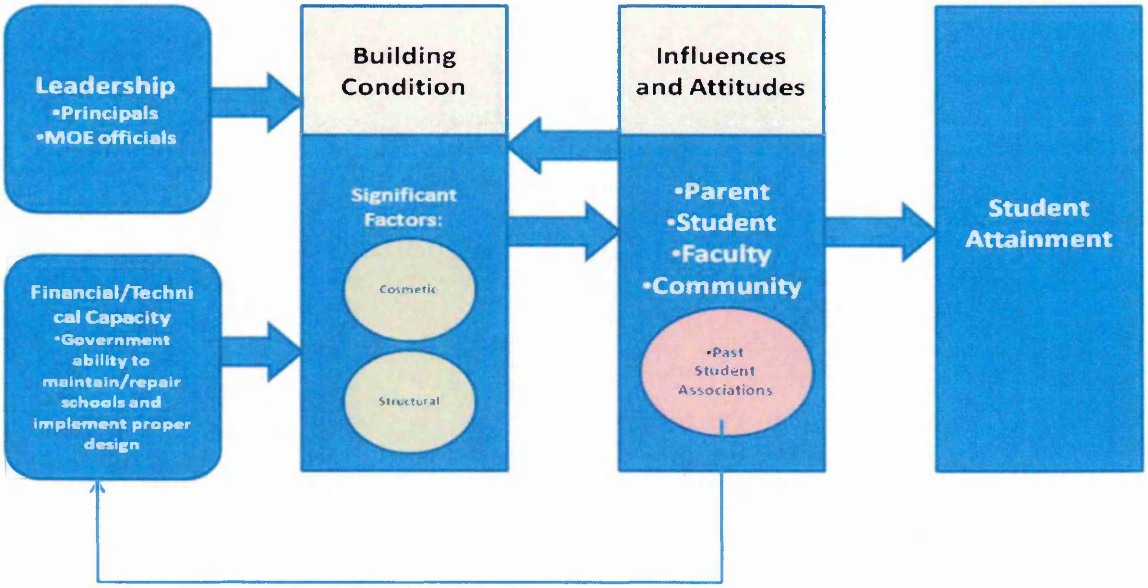

Figure 6.1. A Modified Cash Model.

Leadership - principals and Ministry of Education. Leadership is very important to any organization, the absence of it most times result in failure. The education system in Jamaica is no exception. Principals are responsible for the overall running of the school. That is, the strategic direction of the school is the responsibility of the principal in a changing climate where information technology is changing rapidly and the globalization is pressing in from every angle.

Financial and technical capability. Inadequate finance and technical capability in any school system is a recipe for disaster which translates to inappropriate building facility. Even though the government has increased the budgetary support for education, the provision is inadequate. Principals are therefore required to use their allocation wisely by prioritizing their needs .In addition, they must engage in fund raising supported by the community to aid in sourcing finances.. In this regard, attention must be given to the built environment since it is equally important as other variables such as quality of teachers, curriculum development, social and cultural activities. It is customary for the engagement of technical expertise to be contracted at high cost, however the recommendations of the researcher has identified a way that this expertise can be engaged at no cost or at minimal cost. Limited funding contributes to a number of specific problems relating to school infrastructure, namely

- cheaper building infrastructure,
- poorly designed buildings, and
- insufficiently maintained schools.

The combination of these three factors produce a building or school environment that may hinder the learning process for students.

Building condition. Most of the research conducted to determine the association between building condition (independent variable) and students' attainment (dependent variables) have shown that there is an association between these two variables. Consequently, architects and school administrators have an important role to play in designing and maintaining an environment that provides the best learning opportunity for students. The overall condition of Jamaican school facilities can be divided into two categories, cosmetic and structural. As already discussed, this thesis found an association between building condition, both cosmetic and structural, and students' attainment.

Attitudes. The attitudes of parents, students, and community and faculty members are of vital importance. If the attitude towards the school is good then so is the support for the school. It has been noted earlier in this thesis that some of the problems faced by schools, particularly ventilation and the admittance of fresh air into the school building, result from vandalism by communities and students. If these destructive elements see the school as a center of excellence through their own participation then it is hardly likely that this problem will be significant. Principals are therefore encouraged to make special effort to have communities actively involved in school activities.

Student attainment. High academic attainment at the secondary school level is of vital importance. This thesis demonstrates that there is an association between building condition and student attainment and makes recommendations for the approach that facilitates the optimum design and maintenance of school facilities. If the Jamaican education system is to realize its Vision 2030 goals (Planning Institute of Jamaica [PIOJ], 2009) it would be well-advised to implement the recommendations of this thesis. Jamaicans must be equipped to function in a global environment and accordingly it must pursue initiatives through research to improve student attainment. If the citizens of the Jamaica are to perform optimally, attainment at the secondary level needs to be significantly improved thus facilitating more students to enter university for tertiary level training, and hence advancing the development of the country. It is important to note that the researcher is aware that the CSEC is only one of the ways that student attainment can be measured. This method provides the most cost effective and reliable way of measuring attainment than any other measures which would add to the complexity of this research. Students can show attainment through other means such as achievement in academic competitions, namely the Schools' Challenge Quiz, singing, drama, sports, culture etc. but methodology for accurate measurement of these are yet to be adequately defined.

Standards, Building Design and Maintenance

Current efforts by the Ministry of Education (MOE) to address standardization issues include the fact that the MOE has currently drafted standards for school buildings and general facilities that address design standards, construction document standards and the upgrading of schools. However the draft standards do not sufficiently address factors identified by this thesis as significant to student learning. The draft manual gives a comprehensive review of school facilities but it has not addressed in specific terms design elements of the facilities; for example, it does not give recommendations for ideal window size and noise pollution. The design of precast structures was not addressed, though this type of structure is extensively used throughout the Jamaican school system. Instead it gave recommendations for in-situ concrete structures (those with columns and beams).

There have been noticeable renovations and expansions to school facilities that violate basic design standards, many of which seem to stem from the absence of technical assistance in the areas of building design, construction, and maintenance. It is therefore recommended that the Ministry of Education institutes a Facilities Management Advisory Committee to oversee all renovations and expansion projects. This committee should have the benefit of the competence of architects, structural engineers, electrical and mechanical engineers, quantity surveyors, and facilities managers from schools and major industries. The purpose of this committee would be to pull together core competences in building maintenance, design and construction in order to oversee proposed expansion plans for all educational facilities in the education system. Proposed plans would be tabled at this committee for review to ensure that all design elements are sufficiently catered for, thus ensuring a suitable design for the facility. The tabling of proposed construction and expansion plans must be mandatory so as to ensure that all school facilities are constructed and expanded to minimum acceptable standards. Conversations with some schools principals revealed that schools that are in a better condition benefit from technical assistance through Past Student Associations.

The extent to which design and maintenance affect buildings is based on the availability of finances for maintenance and capital development. Many school buildings are designed just to provide covered space outfitted with basic furniture, with limited space that do not allow furniture to be reconfigured in small groups to facilitate contemporary teaching methods. Lack of physical space hinders teaching flexibility. Maintenance often suffers because of the scarcity of financial resources. In most cases maintenance staffs are ill-equipped, having little knowledge of maintenance. Consequently, maintenance is not carried out in a timely manner. Often sufficient resources are not provided on a timely basis and in the desired quantity to address the schools' maintenance needs.

While it is commendable that a policy document has now been prepared to guide new construction, a more comprehensive Maintenance Manual and Facilities Management System is required to guide maintenance activities. This system should clearly outline the resources that are required, both human and financial. There also needs to be a sustainable way of financing and implementing a program, so as not to cause school facilities to fall back into a state of disrepair after renovations and correction of identified defects.

Strategic Planning For School Facilities

It is part of the natural cycle of things for populations to vary in size and composition. The Ministry of Education should respond to population increases by anticipating and planning for population changes. For example, planned housing and road developments will increase the student population of a town and adequate classroom space must be provided beforehand. The ministry must also address in a proactive way, when school buildings or facilities should be replaced, extended or upgraded, using accurate and systematic data fed by facilities audits and compiled on a yearly basis. This data should be integrated with demographic data and available government and non-governmental plans. In order to facilitate successful implementation of plans that meet the infrastructure needs of school campuses, ensuring the quality of the water, waste disposal and sewage facilities, an inter-agency committee or team should be developed.

Facilities Audit

Personnel at the Ministry of Education need to be aware of the seriousness of the physical condition of schools and its negative impact on educating the nation's pupils. A large portion of buildings that exists in the Jamaican education system suffer from physical, functional and financial deficiencies. A starting point for reform should be to collect information on building condition in the form of a facilities audit. A facilities audit systematically and routinely identifies building and infrastructure deficiencies and functional performance of campus facilities by an inspection programme (Kaiser, 1993).

The provision of long-range planning could provide the information needed for a countrywide inventory system and long-term needs assessment. While the Jamaican education system engages in condition assessment for schools, the information is not used for long-term planning. Neither is this information collected at any particular regular interval. This kind of inventory system is necessary so as to maintain a pool of maintenance needs so that the most critical needs can be addressed on a priority basis.

The coordination of facility planning with other local planning agencies could ensure that school facilities are designed and maintained at a better level, since agencies would have more resources for planning and a greater wealth of technical knowledge. (This is necessary so that school facilities are not designed and constructed contrary to established standards.) The initiative for this collaboration could be undertaken by school principals.

A comprehensive maintenance plan should give a summation of maintenance needs for school facilities and document the types of resources needed for their repairs. Documenting of maintenance needs would provide information in an accessible state, so that when funding becomes available, tender and contract documents can be quickly drafted.

Proposed Institutional Framework

A government and a non-governmental multi-disciplinary team should meet on a monthly basis to oversee standards, and monitor school facilities. The scope of this committee should be broad, applying standards as they relate to variables identified by this research. The lead agency should be the Ministry of Education. Other agencies to be included on the team should be as follows.

- The Statistical Institute of Jamaica (STATIN): STATIN is an agency of the Ministry of Finance and Planning whose main function is "to collect, compile, analyse, abstract and publish statistical information relating to the commercial, industrial, social, economic and general activities and the condition of the people" (Statistical Institute of Jamaica [STATIN], 2014).
- Parish Development Committees (PDCs): PDCs work in collaboration with the Parish Councils (political representatives) as an auxiliary planning arm to address long-term development and resource management issues. Working with communities through structures known as Community-Based Organizations (CBOs), Community Development Committees (CDCs), and Development Area Committees (DACs), a PDC is responsible for facilitating community participation in sustainable development planning.
- National Environmental and Planning Agency (NEPA): NEPA represents a merger between the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilization Commission (LDUC). Its role is "to promote sustainable development by ensuring protection of the environment and orderly development in Jamaica through highly motivated staff performing at the highest standard" (National Environmental and Planning Agency [NEPA], 2014).

- Jamaica Social Investment Fund (JSIF):

  [JSIF] mobilizes resources and channels these to community-based socio-economic infrastructure and social services projects. Through a national partnership between central and local government, communities and private and public organizations, JSIF addresses the immediate demands of communities. JSIF facilitates the empowerment of communities and assists in building national capacity to effectively implement community-based programmes aimed at social development. (Jamaica Social Investment Fund [JSIF], 2014).

- Jamaica Institute of Architects (JIA): The JIA maintains a high standard in the design of the built environment in Jamaica. The Jamaica Institute of Architects ensures the work is safe and that it enhances the community and the environment.
- Urban Development Corporation (UDC): The UDC is the Government of Jamaica's urban developer. It is tasked with creating new and viable urban centers in rural areas to ease the pressure on the existing ones, as well as with improving the urban fabric of metropolitan regions.
- Planning Institute of Jamaica (PIOJ): The PIOJ is the agency of government that leads "the process of policy formulation on economic and social issues and external co-operation management to achieve sustainable development for the people of Jamaica" (Planning Institute of Jamaica [PIOJ], 2014).

Regulations and Inspections

Regulations that relate to the standard of school facilities are lacking and those that do exist are not adequately enforced. Whether the project is funded privately or publicly the same rigour to check conformity to standards must be applied. As it exists now, all plans for public schools regarding location, expansion and renovation of schools are not developed solely by the Ministry of Education. Some are developed through the school principal's efforts and others by private interests with their own source of funding. Additionally all such plans are not submitted to the Ministry either for approval or administration of the project. Those plans that are government initiatives are developed by the architect in the Ministry of Education and then submitted to the Parish Council for approval as are all building plans. However, Ministry officials reported that they sometimes do not get notification beforehand of planned renovations and that it is only when Ministry officials visit the schools that they realize that construction is taking place or has occurred. A building that is found to be non-compliant with standards or erected without approval should be closed until it satisfies all requirements and if it does not achieve compliance within a specific time, should be demolished. Should breaches still occur, the government as part of its function, either through the Ministry of Education or the Ministry of Local Government and Parish Development Committees (PDCs) must ensure that this is done.

Training

Site visits revealed that principals were not consistent in their responses to variables relating to the school facilities as answers provided on the questionnaires were made based on the principal's own experiences. A constraint of this thesis is that answers given to questions that relate to the condition of buildings could vary widely according to the perception and personal taste of the principals. These inconsistencies could be addressed to some extent by the refinement of standards and the implementation of associated training. The refined standards should be informed by research that identifies the factors that encourage student learning and by best practices in industry. Principals and school boards should have regular training in procedural guidelines for the expansion and renovation of school facilities as well as facilities and maintenance issues. In Jamaica the condition of classroom windows, bathrooms, ceilings and roofs was significant, so focus should be placed on training with regard to window repair, bathroom maintenance and repairs to roof and ceiling. As an adjunct to this training, all manuals on procedures must be updated to address the specific factors that have been identified through this research and then be disseminated to schools.

Each school should possess the basic skills and competence to do minimum maintenance of school facilities. Training should be mandatory for principals, but also offered to custodial staff, on both grounds and building management and maintenance. It is imperative that these skills be honed in-house so that all school maintenance staff can respond in a timely manner to maintenance needs in these areas. This competence can be developed through training which can be developed with tertiary level-training institutions such as HEART Trust/NTA and the Vocational Training Development Institute (VTDI).

The Social Role and School Culture in the Expansion of the School Life Cycle

Some schools depend heavily on income from Past Student Associations. It was observed that students attending these schools develop in a culture of fierce pride in the organisation and its achievements. This inculcates a lifelong commitment to high standards of achievement and behaviour in the student. Similar high standards are expected of the facilities, and the grounds are more likely to be well maintained. Such past students often feel honour-bound to support fundraising initiatives of the school for the duration of their lives. Well maintained facilities only enhance such pride. Some schools in Jamaica have so developed this model that their range of supporters extends beyond past students to encompass wider members of the community that admire the spirit, high standards and work ethics of the school.

For this model to work, high standards are expected and must be maintained and displayed at all times by students and teachers of the school. Three identified components help to ensure high standards of student achievement and behaviour as well as high performance of the school leadership (teachers and principals). These are

- a strong leadership team, i.e. principal, teachers and school board;
- the engagement of the wider community;
- and Ministry of Education oversight.

School boards, entrusted with the operational management of schools on a daily basis, must display strong leadership. The community must also be hyper-vigilant in monitoring the behaviour of students and ensuring that the schools facilities are of high standard. This tripartite arrangement including the Ministry of Education, community groups and the school (including board/past students) is an arrangement of co-management that needs to be further understood. School culture, community and Past Student Associations may also have a significant role in the extension of the school building cycle described below.

School building cycle. The building life cycle refers to the view of a building over the course of its entire life, taking into account the design, installation, commissioning, operation and decommissioning phases (see Figure 6.2). The building life cycle is relevant in determining improvements to building condition such as flooring, roofing, walls etc. and how the life cycle relates to the purpose and hence the design of the building. It is important for school officials and Ministry of Education personnel to ensure that the purpose of the building is the foundation on which the design of the building is built. Other factors such as cost and security features, although they are important considerations, must be secondary. It is essential therefore for authorities who plan, design and maintain schools to bear in mind that school buildings are to be built with the foremost thought that the function of the building is to provide a space where children will be able to learn at an optimal level. School buildings must be designed, built and maintained to facilitate the greatest possible level of learning. If precast structures are encouraged because they are more affordable, more effort should be put into determining the design of a precast building that encourages high levels of learning, with sufficient emphasis placed on lighting and ventilation. A whole-life view of the school building should also be taken into account for expansion and renovation of the buildings. Considerations should include whether the design chosen will easily accommodate additions, especially if it is identified during strategic planning at the Ministry of Education that the population of the area is likely to increase. Other considerations would include the cost and availability of materials and expertise for repairs and maintenance, and energy efficiency.

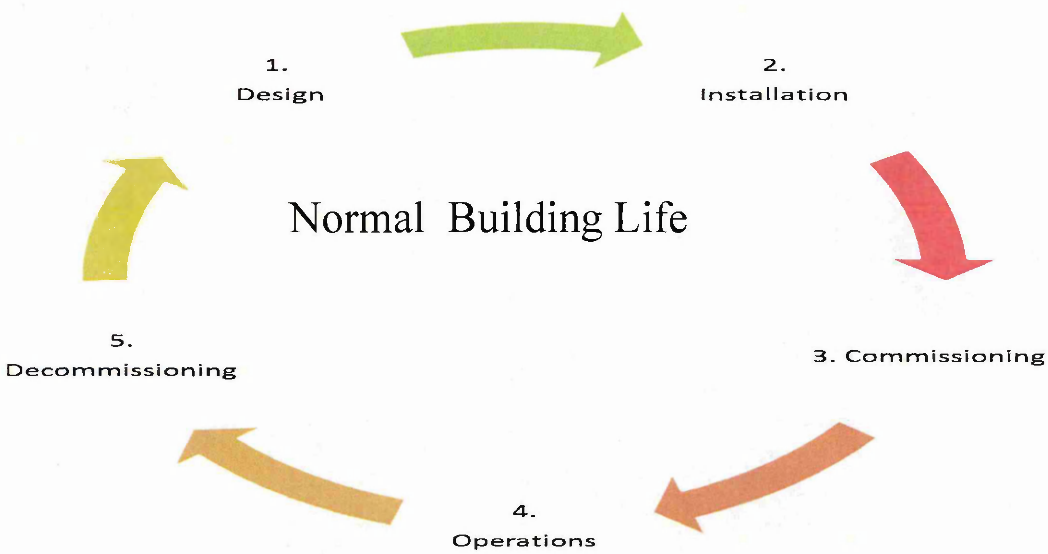

Figure 6.2. The Normal Building Life Cycle

Extension of school building life cycle. Unlike the procedure in other countries where decommissioning means that the entire structure is demolished and the school populace is temporarily displaced and reassigned, in Jamaica a school building is rarely fully decommissioned in this manner unless the population moves from the area, or there is an environmental catastrophe. Rather school buildings are renovated, sometimes repurposed, and the useful life of the building stock is extended by timely injection of funds. Instead of full decommissioning, a school may choose to repair or renovate--often one classroom or classroom block at a time. In this manner there is less need for drastic shifts of the school populace and disruption in student and community life. These sort of repairs are constant throughout the school year, but are increased in intensity in the summer months when there is a break in classes. The building life cycle may be extended for many years in this manner (see Figure 6.3).

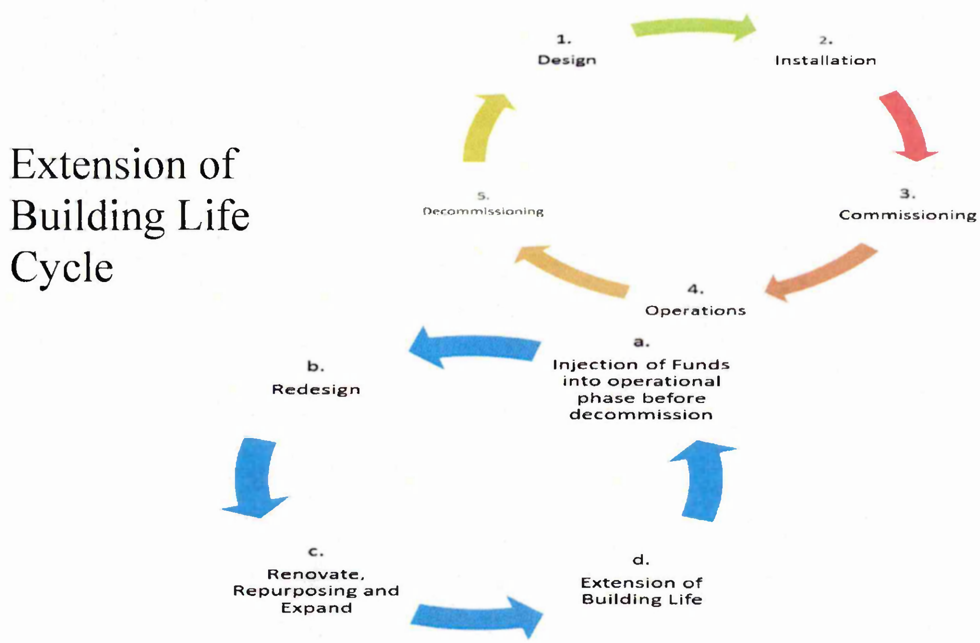

Figure. 6.3. Extension of School Building Cycle

The injection of funds needed to effect repairs may come from the government which will consider that in most cases repairing a building is less costly than erecting a new building. Alternatively funding may come from non-government sources such as overseas funding/aid, private companies and donors. The drawback with reliance on the government consolidated fund is that the funds available are usually inadequate and may take longer to be released for renovation and the school remains in disrepair for longer periods of time. During this time such school buildings do not perform optimally and students do not perform optimally. In contrast, funding obtained through private sources may be more readily available and, theoretically, a shorter time would then be taken for renovation and school buildings would be capable of optimal performance earlier. Schools that are supported in renovation and repair by funding obtained through their community or Past Student Associations, in particular, are able to affect repairs quickly and effectively. This is an interesting link as it has been noted in this thesis that older schools perform better academically than younger schools. This may be due to the financial and technical guidance and input from strong Past Student Associations that are found in older schools.

Government could play a role by fostering fundraising initiatives through training of school boards or specialised personnel at the Ministry of Education to write proposals for donor funding, perhaps centralizing the effort. The proposed Facilities Management Advisory Committee as their terms of reference (or perhaps the Ministry through dedicated personnel) could be responsible for seeking grants, endowments or low interest loans that would be dedicated to the improvement of facilities. They would also be responsible for prioritizing which schools get access to funding for repairs, renovations and extensions, based on systematic facilities audits as discussed above.

Contribution to the Literature and Practical Applications

Contributions that this thesis can make to the body of knowledge on Facilities Management for Jamaican schools include the following points.

- Design deficiencies are significantly associated with students' academic performance in the Jamaican education system.
- Deficiencies in maintenance of school facilities are associated with students' academic performance in the Jamaican education system.
- Schools constructed from precast system have more design defects that those constructed from column, beams and precast block construction.
- Sole efforts by some principals to cater to increased school populations have created facilities that are uncomfortable for both students and staff.
- Noise generating facilities near to classrooms are negatively impacting students performance.
- Some of the modifications and construction actions run counter to architectural design considerations observed during the design phase of the buildings. During site visits it was observed that some schools that were renovated and expanded in a way that conflicted with the original design consideration of the school campus. In some instances the new buildings were located too near to existing buildings and blocked natural ventilation, significantly reducing natural lighting.

Limitations of the Study

The MCAPE did a reasonable job in determining the condition of building, but it had several limitations. These include the fact it did not provide continuous independent variables for most of the elements investigated. Accordingly, Spearman's Rho was not applied to most of the variables with the exception of Building Age which was quantitative. Other variables were categorical and only facilitated analysis with Mann-Whitney and Kruskal-Wallis tests.

Consequently advanced statistical analysis could not be applied and this limited the rigour of data analysis.

As advised by Cash (1993), instruments of this nature are limited by the objectivity of the data. For the purpose of this research, site inspections were done to verify information given on the questionnaires. However:

- The MCAPE was limited in assessing the multiplicity of factors that affect learning and variable omissions could have led to a high or low association of variables included in the research.
- The MCAPE did not account for students that were not allowed to sit the examination because of prior screening.
- The MCAPE was completed only by principals of the schools.
- School principals had different perceptions of maintenance standards. This affected the consistency of the answers to the questions.

Further limitations identified with the thesis included:

- The study does not take account of the practice of screening of students from primary schools for select secondary schools, giving some schools what is perceived as an unfair advantage in achieving academic success.
- This research gave a limited account of factors beyond the school yard and the screening of students before entering high schools.

Recommendations for Further Research

Research conducted by Cash (1993) in the field reported that the built environment accounts for up to 30% of student's academic performance. This therefore means that there are other factors contributing to the poor performance of the Jamaican students. The two open-ended questions from the questionnaire provided a rich body of knowledge from the school principals that should be further explored. The call therefore is for other academic disciplines to do further investigations to determine precisely what are the other contributing factors hindering the performance of the students in Jamaica.

In light of the findings of this research, in particular that despite the old schools in disadvantaged areas and those that are in poor condition, nevertheless the students attain high academic scores, further research needs to be undertaken at these schools. This research, along with others, have confirmed that a link exists. What is now needed to be understood is the nature of the link. Chapter 5 attempted to explore some of the schools that are high-performing in spite of building conditions, but a more in-depth analysis is needed to get a fuller understanding of the intervening issues. In the study done by Uline and Tschannen-Moran (2008), teachers from 80 Virginia middle schools were surveyed as well as three resource support items.

> Data on student [socioeconomic status] SES, and student attainment were also gathered. Bivariate correlational analysis was used to explore the relationships between the quality of facilities . . . and student achievement . . . multiple regression was used to test school climate as a mediating variable between the quality of facilities and student achievement. (Uline & Tschannen-Moran, 2008, p. 55)

From their analysis the results confirmed a link between the quality of school facilities and student achievement in English and Mathematics. In addition, quality facilities were significantly positively related to three school climate variables. Also, the results confirmed Uline and Moran's hypothesis that school climate plays a mediating role in the relationship between quality of facility and student achievement.

Subsequently, Uline, Tschannen-Moran and Wolsey (2009) published their research against the background that recent studies had connected quality school facilities to student outcomes including achievement, behaviour, and attitude as well as to teacher attitude and behavior. Their research aimed "to examine the link between school building quality and student outcomes through the mediating influence of school climate" (Uline et al., 2009, p. 400). The methodology that was used to facilitate this follow-up research was

> structured according to a collective, instrumental case study design. Individual, focus group, walk-through and photo-interviews, as well as observations inform the inquiry. Two high-poverty schools are identified from the earlier quantitative study because the ratings of the quality school facilities by their faculties fall within the upper quartile. (Uline et al., 2009, p. 400).

The findings of the research by Uline et al. (2009)

> indicate that ongoing interactions between the original design, the day-to-day reality of the built environment, and the occupants of that environment help to define the learning climate of these schools. Reciprocally, the climate helps to shape the interactions that take place, fostering environmental understanding, competence and control and supporting academic interaction between the built environment and building occupants, including movement, aesthetics, play of light, flexible and responsive classrooms, elbow room, and security. (Uline et al., 2009, p. 400).

The research by Uline et al. (2009) presented a new paradigm in the field of building condition and students' attainment and it not only established that there was a link between facility condition and students' academic performance, but argued that there is an intervening variables termed "school climate". This finding therefore signaled a departure from the traditional Cash-based correlation studies that mostly confirm a link between facility condition and attainment, but does little to confirm the cause of the link thus pointing to an improved method that could specifically state the reason for students' poor performance.

The researcher of this thesis did not look at school climate as a variable or as an intervening variable and therefore suggests that this topic needs to be researched in the Jamaican context. This study confirms that there is a link between the condition of buildings and students' attainment. So, while the finding of Uline et al. (2009) indicated that there is an ongoing interaction between the original design, the day-to-day reality of the built environment, and the occupant of the environment, it does little to answer the question posited by this thesis and therefore calls for similar research in the Jamaican context. Notwithstanding, the attempt to establish that a there is a mechanism in the form of an intervening variable between facility condition and students' attainment is of significance and may very well aid school administrators in tackling the problems relating to students' poor academic performance.

It is also important to give consideration to principals' responses to the last two questions on the MCAPE to determine if these variables that affect school climate are intervening variables between building condition and students' attainment. The other factors that the principals reported that were contributing to students poor academic performance were literacy, resources and finance, school attendance, teacher commitment, difficulty commuting to school, health and nutrition, inadequate school building, student characteristics and home environment.

Overall Recommendations of the Research

Jamaica has a sluggish economy, and the yearly allocation to finance, maintain, and construct schools is dwindling. The government must take the decision to make financing of education the number one priority. Deferred maintenance, has out lived its utility as the old stock of school buildings is reaching the end of its useful life.

The findings of this study provide convincing evidence that building condition and student attainment are associated. The government of the day must now translate the findings of this research into a Terms of Reference in order to appoint planners and designers. Also there needs to be a contractor to remedy the identified defects and, with immediate effect, to discontinue the construction of school facilities with these design defects. Buildings that are in a bad condition affect students' performance directly and indirectly, since defects in buildings normally hinder the learning process. The cost to build and maintain takes up an average of 10% of the nation's budget, although by comparison with other Caribbean countries Jamaica spends the least per gross domestic product (Davis, 2004).

As better academic performance has been associated with schools with better school buildings, a concerted effort should be made to design, construct, expand or renovate and maintain facilities that will encourage student attainment. Overall recommendations arising from the research are as follows:

1. The design, condition, expansion and location of educational facilities in Jamaica should be regulated to ensure that environments are created to facilitate learning. As the link has been shown between poor student attainment and uncomfortably hot classrooms, the design of buildings must be modified to ensure that rooms are cooler and better ventilated. This could be accomplished by increasing the size or number of window openings and increasing the height of the ceiling. Landscaping could also be creatively employed to reduce the temperature of classrooms by providing pleasant

shading throughout the school grounds by tall trees. Landscaping also reduces dust nuisance, thus providing a cleaner environment with less cleaning costs.

2. Update and enforce regulations regarding school facilities and maintenance to include the findings of this research, disseminate the information and train stakeholders. A standardized maintenance programme should be implemented were none exists. As alterations made to school buildings in order to accommodate expansions have further compounded facilities issues and increased the discomfort of students and staff, it is suggested that all expansions that are currently affecting the basic functionality of school buildings be demolished or altered based on the recommendations of a registered architect and at the same time, newly fabricated buildings should be designed to basic standards.
3. Strengthen the capacity of the Ministry of Education to design, plan and administer facilities projects by addressing organizational, technological, staffing capacity and funding issues. A detailed assessment needs to be done to determine capacity gaps and the Ministry's five-year strategic plan should address these. Conversations with Ministry personnel have indicated that attention needs to be paid to the span of control of existing officers, in order to increase efficiency in the system. The Ministry of Education must acquire technical skills which are currently lacking in the Ministry, including electrical and mechanical expertise.
4. Implement routine facilities audits in order to ensure that building facilities provide maximum utility. A routine system of audits conducted by the Ministry of Education would aid in prioritizing deficiencies, thus assisting with the direction of scarce resources to the areas where they are most urgently needed. Prioritization criteria

should include schools suffering from health and safety issues caused by low maintenance, classrooms with limited air exchange and high temperatures, low ratio of window area to floor area and high incidence of noise disruption from external sources.

5. Further capacity needs to be built within the Ministry of Education by investment in appropriate computer technology and software, in order to keep a better track of the state of facilities, the status of building plans and approvals, construction and implementation of plans and audits. In addition the appropriate model of facilities management system needs to be employed that is suitably flexible to cater to the multiple locations and disparities of Jamaican school facilities.
6. Further studies on the role of society and community influence on the behaviour of students must be conducted. The Ministry of Education should seek out and utilise as models, examples of excellence that incorporate the wider society of stakeholders in the management of schools. These include active alumni, community groups, churches, non-governmental organizations (NGOs) and corporate entities. Stories of excellence and the development and role of Past Student Associations and other forms of community support, need to be documented and used as a model for other schools. The Ministry of Education should play a role in fostering the development of new partnerships among these groups by providing a medium for collaboration.
7. Non-facilities issues such as those indicated by principals in answer to open-ended questions must be given further consideration. The principals informed that peer pressure, social unrest in community and negative community influence, absence or presence of parental support, poverty and poor finance, poor diet and nutrition, poor

work attitude, students not taking responsibility for their actions, dancehall culture and the distance schools are located from students' homes are some of the other major problems affecting the school system. Addressing these issues would require the input and intervention of other government ministries and agencies, in particular, the Ministries of Health, Local Government and Youth and Culture. The Ministry of Education should liaise with these ministries on policy matters to ensure a cross-sector response that would be more sustainable.

The implementation of the recommendations of this research is therefore imperative in order to limit the effects of the factors that were found to be significant.

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Appendices

Appendix A: Acronyms

Term	Definition
ASTEP	Alternative Secondary Transitional Education Programme
CAPE	Commonwealth Assessment of Physical Environment
CAST	College of Arts, Science and Technology
ITBS	Iowa Test Basic Skills
MCAPE	Modified Commonwealth Assessment of Physical Environment
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

Appendix B: CAPE Questionnaire

Commonwealth Assessment of Physical Environment (CAPE) Instructions: Please indicate the status of your facility in each area by circling the most appropriate description for each of the following questions. You may provide additional information in the space provided after each question.

SURVEY INSTRUMENT

1. What is the age of your facility?
(A facility's age is your best estimate of the time period during which most of the space used by students was built. If the space was fully updated to the building standards of a later time period, consider the school in the later time period.)
a. 60 years old or older
b. 50 – 59 years old
c. 40 – 49 years
d. 30 – 39 years
e. 20 – 29 years
f. 10 – 19 years
g. Under 10 years old

Comments: ____

2. Are windows in each instructional space (classroom)?
a. Windows are in fewer than 1/4th of the instructional spaces
b. Windows are in at least 1/4th, but fewer than 3/4th of the instructional spaces
c. Windows are in the least ¾ of the instructional spaces

Comments: ____

3. What kind of flooring is found in the majority of the instructional spaces?
a. Wood floor
b. Tile or Terrazzo
c. Carpet

Comments: ____

4. What quality of heat is found in the majority of the instrumental spaces?
a. Uneven heat/unable to control in each room
b. Even heat/unable to control in each room
c. Even heat/able to control in each room

Comments: ____

5. What quality of air conditioning is found in the majority of the instrumental spaces?
a. No air conditioning in the facility
b. Air conditioning in some instrumental spaces, or air conditioning in all instrumental spaces, but not well-regulated
c. Air conditioning in all instrumental spaces which can be well-regulated

Comments: ____________________

6. When was the last time the interior walls, including classroom spaces, were painted?
a. Over 15 years ago
b. Between 8 and 15 years
c. Less than 8 years ago

Comments: ____________________

7. Is there a regularly scheduled painting cycle for interior walls? If so, what is it?
a. No
b. Yes; over 8 year cycle
c. Yes; 8 year or fewer cycle

Comments: ____________________

8. When was the last time the exterior walls or windows & trim were painted?
a. Over 7 years ago
b. Between 4 and 7 years
c. Within the last 4 years or no exterior surface requires periodic painting

Comments: ____________________

9. Is there a regularly scheduled painting cycle for exterior walls, or windows & trim? If so, what is it?
a. No
b. Yes; over 7 year cycle
c. Yes; 7 year or fewer cycle or not needed because no exterior surface requires periodic painting

Comments: ____________________

10. Are there visible indications of roof leaks?
a. Ceiling is deteriorating due to water damage, and/or water falls in some areas of facility requiring buckets for water collection
b. Ceiling is currently developing a few new stains due to minor leaks
c. No visible signs, or only a few old water spots in ceiling

Comments: ____________________

11. Which of the following facilities are adjacent to, or part of, the school complex? Please circle all that apply
a. Football stadium
b. Baseball field
c. Soccer field
d. Tennis court (circle the number of courts)
   1 – 2
   3 – 5
   Over 5
e. Swimming pool
f. Softball field

Comments: ____

12. How often are in the instrumental area floors swept (if wood, tile, or terrazzo) or vacuumed (if carpeted?
a. Monthly
b. Weekly
c. Daily or more frequently

Comments: ____

13. How often are the instrumental area floors mopped (if wood, tile or terrazzo) or cleaned (if carpeted)
a. Annually
b. Monthly
c. Weekly or daily

Comments: ____

14. Is graffiti commonly found on premises? Circle yes or no for each listed area.
a. Bathrooms
b. Lockers
c. Hallways
d. Classroom walls/doors
e. Other interior surfaces, please specify ____________________
f. Exterior walls
g. Exterior walkways
h. Other exterior surfaces, please specify ____________________

Comments: ____

15. How long does the graffiti remain before it is removed?
a. Until summer maintenance or the next painting cycle
b. More than a week, less than a month
c. Less than a week or no to all parts

Comments: ____

16. What is the condition of the lockers?
a. Most are not functional or not in good repair
b. At least three-fourths of the lockers are functional and in good repair
c. Over three-fourths of the lockers are functional and in good repair

Comments: ____

17. What type of material is used for interior ceilings?
a. Wood or open beams
b. Plaster or acoustical tiles in at least three-fourths of the instructional spaces
c. Acoustical tiles throughout the instrumental spaces

Comments: ____

18. Please indicate which utilities or equipment are available and in useable condition in the science labs (please circle all that apply).
a. GAS
b. WATER
c. SINKS
d. ELECTRICITY

Comments ____

19. How long ago was science equipment updated to current standards?
a. Over 10 years ago
b. Between 5 and 10 years ago
c. Less than 5 years ago or the building is less than 5 years old

Comments: ____

20. What type of lighting is available in the instrumental areas?
a. Incandescent lighting
b. Fluorescent lighting – hot
c. Fluorescent lighting – cold

Comments: ____

21. What is the condition of the classroom furniture?
a. Most rooms have furniture that is either facially scarred or functionally damaged
b. Though at least half the rooms may have some minor facial scars on the student desk, all the furniture is functionally sound and looks satisfactory
c. All the classrooms have furniture which is functionally sound and facially attractive

Comments: ____

22. What is the condition of the school grounds?
a. There is no landscaping, and sidewalks are either not present or damaged (it is unattractive to the community)
b. There is landscaping and the sidewalks are present and in good repair (it is acceptable to the community
c. The landscaping and other outside facilities are attractive and well-maintained (it is center of the pride of the community)

Comment: ____

23. What colour are the walls in the instrumental areas?
a. Dark colours
b. White
c. Pastel colours

Comments: ____

24. Is the facility located near a busy, major highway, a frequently used rail line, an area where aircraft frequently pass overheard, or any other loud noise producing environment?
a. Yes and no measure have been taken to reduce the level of noise within the facility
b. Yes, but measures have been taken to reduce the level of noise within the facility
c. No

Comments: ____

25. What do you consider to be the condition of your facility cosmetically and structurally?
a. Below standard
b. Standard
c. Above standard

Comments: ____

Please provide the following information if you can.

26. What is the approximate gross square footage of the facility? (Use buildings' rough dimensions.)

Length X Width = Gross Square Feet

27. What is the approximate acreage of the school site?
a. _______________ (acreage)

If there are any areas on this assessment instrument which you feel require further comment, please note them and your comments in the space provided. Thank you for your time and assistance in completing this assessment of your facility's physical environment.
Comments:

If you have any comments regarding the possible relationship between building condition and student behaviour or student achievement, please make them below.
Comments:

If you would like to have a summary of the results of this study, please include your name and address in the space provided.

Yes, I would like a copy of the results of this survey.

NAME

ADDRESS

BEHAVIOUR, ACHIEVEMENT AND FREE/REDUCED LUNCH INFORMATION

INSTRUCTIONS:
The following information is needed in order to complete research on the relationship between facility condition and student achievement and behavior. You may attach documents which provide this information or transfer the information to this form. Then return this form with the completed building assessment instrument in the envelope provided.

1. Please indicate the school's achievement test (TAP) results for 11th grade students in the _____ school year, as found on the administrative summary in scale scores. [you may attach the division wide report for grade 11 as long as it lists the schools separately and the scores for each of the sections: reading comprehension, mathematics, written expression, information, basic total, social studies, science, composite total]

Reading Comprehension	Basic Total
Mathematics	Social Studies
Written Expression	Science
Information	Composite Total

Please indicate the number of students (or the percent of membership eligible for free/reduced lunch during the _____ school year, as reported to the division __________. [You may attach the division wide report of ____ as long as it lists the school separately and gives a total for free and reduced lunches or a percent of membership qualified for free and reduced lunches.]
Number of students qualified for free meals________________
Number of students qualified for reduced meals _____________
Percent of membership qualified for free/reduced meals ___________

2. Please indicate the number of suspensions, in-school and out-of-school as reported to the division for students in the grade 9 and above.
Number of expulsion ___________________
Number of in-school suspensions _______________________
Number of our-of-school suspensions ____________________

3. Please indicate the number of incidents of crime and violence duing the ____________ school year as reported to the division for the state report mandated in the code of __________

	Grade 9	Grade 10	Grade 11	Grade 12
Physical Assault: Staff by students				
Students by students				
Sexual Assault: Staff by students				
Students by studens				
Students by non-students				
Homicides on: Staff by students				
Students by students				
Students by non-students				
Possession of weapons				
Possession of drugs				
Possession of alcohol				
Possession of Tobacco				

Appendix C: Modified CAPE Questionnaire

Sheffield Hallam University

ASSESSMENT OF

BUILDING AND CLASSROOM CONDITIONS IN

JAMAICAN HIGH SCHOOLS

2010

SURVEY CONDUCTED BY

O'Neil Ryan Roper

SHEFFIELD HALLAM UNIVERSITY, UNITED KINGDOM

INSTRUCTIONS:

You are asked to rate specific features of your school building and classrooms as well as provide certain demographic information regarding your school. Please use your best judgment and experience as the Principal to answer these questions, by either ticking the best response for each question or filling in the appropriate blank.

Jamaica School Building Condition Survey

1. What is the name of your school?

____

2. What type of school is this? Please select all that apply.

O Male O Female O Co-ed

O Boarding O Shift System

O Other, please specify ___________________________________

3. What is the age of the school building in years?
(A facility's age is your best estimate of the period during which most of the space used by the students was built.)

O Under 20 years O 21-40 years O 41-60 years

O 61-80 years O 81-100 years O 101-120 years

O 121-140 years

4. Are there windows in each classroom?

O Windows are less than ¼ of the classrooms

O Windows are in at least ¼ of the classrooms

O Windows are in at least ¾ of the classrooms

5. Are the windows in poor condition?

O Yes, they are in terrible condition O Yes, they are in poor condition

O Not sure O No, they are in good condition

O No, they are in excellent condition

6. Is the lighting in the classroom poor?

O Yes, the lighting is terrible   O Yes, the lighting is poor

O Not sure   O No, the lighting is good

O No, the lighting is excellent

7. Are the classrooms very hot?

O Yes, they are unbearably hot most of the time   O Yes, they are hot sometimes

O Not sure   O No, they are not hot most times

O No, they are cool at all times

8. When was the last time the classrooms were painted?

O Over 15 years ago   O Between 8 and 15 years ago

O Less than 8 years ago

9. Are the interior walls in poor condition?

O Yes, they are in terrible condition   O Yes, they are in poor condition

O Not sure   O No, they are in good condition

O No, they are in excellent condition

10. Are the exterior walls in poor condition?

O Yes, they are in terrible condition   O Yes, they are in poor condition

O Not sure   O No, they are in good condition

O No, they are in excellent condition

11. Are the ceilings in poor condition?

- O Yes, they are in terrible condition
- O Yes, they are in poor condition
- O Not sure
- O No, they are in good condition
- O No, they are in excellent condition

12. Which of the following are close to, or part of, the school's complex? Please select all that apply.

- O Airport
- O Heavy vehicular traffic
- O Operational railway station or tracks
- O Operational construction site
- O Metal and/or woodwork shop
- O Sports or Community facility

13. What is the cleaning schedule for the classroom?

- O They are cleaned three times a day
- O They are cleaned twice a day
- O They are cleaned once a day
- O They are cleaned every week
- O Other, please specify

14. Are the numbers of bathrooms sufficient to meet the needs of the students?

- O Yes
- O No
- O Don't know

15. Are the bathrooms in poor condition?

- O Yes, they are in terrible condition
- O Yes, they are in poor condition
- O Not sure
- O No, they are in good condition
- O No, they are in excellent condition

16. What is the cleaning schedule for the bathrooms?

O They are cleaned hourly

O They are cleaned three times a day

O They are cleaned once a day

O They are cleaned weekly

O Other, please specify

17. Is graffiti commonly found through the school?

O Graffiti is commonly found

O Graffiti is sometimes found

O Graffiti is rarely found

O Graffiti is never found

O Not sure

18. What is the condition of the classroom furniture?

O Most rooms have furniture that is either scarred or functionally damaged

O Though at least half of the rooms have some minor facial scars on the student desks, all of the furniture is functionally sound and looks satisfactory

O All the classrooms have furniture which is functionally sound and attractive

19. What is the condition of the school grounds?

O There is no landscaping, and sidewalks are either not present or damaged (it is unattractive to the community)

O There is no landscaping and sidewalks are present and in good repair (it is acceptable to the community)

O The landscaping and other outside facilities are attractive and well maintained (it is a centre of pride for the community)

20. What color are the walls in the classrooms?

O Dark colors   O White

O Pastel colors   O Other, please specify:______________________________

21. Please indicate the number of expulsions during the year 2008-2009.

____

22. Please indicate the number of students suspended during the 2008-2009 school year.

____

23. How many incidents of physical assault were committed by Grade 11 students during the 2008-2009 school year?

____

24. How many incidents of sexual assault were committed by Grade 11 students during the 2008-2009 school year?

____

25. How many incidents of homicide were committed by Grade 11 students during the 2008-2009 school year?

____

26. How many Grade 11 students were found in possession of illegal weapons during the 2008-2009 school year?

____

27. How many Grade 11 students were found in possession of alcohol during the 2008-2009 school year?

____

28. How many Grade 11 students were found in possession of illegal drugs during the 2008-2009 school year?

____

29. How many students at your school accessed financial assistance during the 2008-2009 (specifically the Programme for Advancement Through Health Education – PATH)?

____

30. List any other factor that you think may impact on the student's attainment.

____

____

31. Compared to other factors that influence student attainment, how important do you believe is the physical building?

____

____

Appendix D: Letter from Sheffield Hallam University

Direct Line: (+44) 114 225 4032
Fax (+44) 114 225 4038

18 April 2007

Mr. Jasper Lawrence
Chief Education Officer
Ministry of Education and Youth
2-4 National Heroes Circle
Kingston 4
Jamaica

Dear Sir

Mr ONeil Roper

I am pleased to confirm that the above is registered with the Faculty of Organization and Management of this university as a candidate for a degree of Doctor of Business Administration (DBA) specializing in Facilities Management.

As a requirement of that degree the candidate is required to undertake a programme of original research and defend a doctoral thesis. The work must demonstrate an original contribution to business or professional knowledge and practice. In due course it can be archived as commercially confidential. The programme is designed so that the degree carries the same rigorous requirements and status as the more traditional DBA. Our Facilities Management Graduate Centre, which is the largest FM Faculty in the UK, has been offering the DBA degree since 2003 emphasising evidence based research into the contributions facilities make to those who use them.

ONeil hopes to examine for links between facilities design and condition and the educational attainments of primary school pupils in Jamaica. Although the subject is under researched work by other students in the UK and reviews of the existing literature encourage my belief that the research is likely to be sensible and has the potential to enhance decision making and wider goals of raising standards.

I understand that this letter from me is a pre-requisite of ONeil being granted access to the data needed for his research and would be most grateful if that permission can be granted. I can of course assure you of the confidentiality of the research and examination programme.

With thanks in advance

Yours sincerely

Professor Ilfryn Price

Appendix E: Letter to the Ministry of Education Requesting Permission for Pilot Testing

University of Technology, Jamaica
Townhouse #2
237 Old Hope Road
Kingston 6

November 11, 2008

Chief Education Officer
Ministry of Education and Youth
2-4 National Heroes Circles
Kingston 4

Attention: Mr. Jasper Lawrence

Dear Sirs:

Re: Permission to Pilot Test Questionnaires

Further to my letter to you dated April 14, 2008, I hereby request the assistance of the Ministry of Education and Youth in conducting my research. The research topic is "*Building Condition, Student Achievement and Behaviour in Jamaican High Schools*". In order to complete this research, data on students' achievement, their behaviour and students with financial needs as well as the building conditions will be required for each of the schools that will be included in the research.

The names of the participating schools will be listed in the appendix of the research: however, individual schools will not be identified by school number, name or division in the body of the research. The intent of this research is not to compare schools, but rather to look at the overall relationship between the school's condition, academic achievement and student's behavior while protecting the anonymity of each school's information and facility assessment. The main objective is to identify the factors that have significantly impact on attainment and behaviour.

I am requesting the assistance of the Ministry of Education and Youth with the following specific activities:

- Permission to pilot test ten (10) questionnaires in the schools listed below:
    - Vauxhall High — Excelsior High
    - Mona High — Westwood High
    - Mount Alvernia High — Little London High
    - Mile Gully High — Kellits High
    - Charlemount High — Spanish Town High

- Distributing questionnaires to the school principals or administrator most knowledgeable about the school after the pilot testing is completed.
- Providing external examination results by subject (mean result per subject) for the years 2007-2008 for the past five (5) years.

The results of this research will provide valuable information to school administrators and policy makers regarding conditions which affect student outcomes in achievement and behaviour.

In the event you have questions or require clarifications you may contact me at University of Technology, Jamaica, 927-1680-8 extension 2450-2, cell phone 995-4635 or email at oroper@utech.edu.jm.

Yours sincerely,

O'Neil Ryan Roper,

Doctor of Business Administration Student
Sheffield Hallam University
Sheffield, UK

Appendix F: Letter to Principals re Pilot Testing

November 7, 2008

The Principal
Jamaica College
Hope Road
Kingston

Attention: Mr. Ruel Reid

Dear Sir,

Re: Pilot Testing Questionnaire

I am a Sheffield Hallam University student pursuing a Doctor of Business Administration (DBA), in the Faculty of Organization and Management, specializing in Facilities Management. My research will be looking at the extent to which the condition of the facility facilitates learning in secondary schools. Specifically, the condition of the facility will be matched against student attainment.

Your school is among nine other schools selected for pilot testing. I have attached a questionnaire that I would like your assistance in completing and returning in the self-addressed envelope in two (2) weeks time. I consider this research important since it will establish whether a correlation exists between school conditions and student attainment at the secondary school level. The results of this study will then be made available to advise the design, modification and construction of school facilities in Jamaica. The research will be conducted over the next three years commencing in April 2008.

The data will be handled confidentially and the findings will be reported in a summary form without identifying respondents or naming any school.

I will be grateful for your assistance in this matter. I may be contacted at telephone numbers 995-4635 or 927-1680-9 extension 2450 or email address oroper@utech.edu.jm.

Yours sincerely

....
O'Neil Roper

Appendix G: Letter from the Ministry of Education Permitting the Administration of the Modified CAPE

REPLY OR SUBSEQUENT REFERENCE TO THIS COMMUNICATION SHOULD BE MADE TO THE PERMANENT SECRETARY AND THE FOLLOWING REFERENCE QUOTED

NO. G540/017

Ministry of Education
2 National Heroes Circle
Kingston 4
Jamaica, West Indies
www.moe.gov.jm

May 12, 2010

Dear Principal,

The bearer of this letter, Mr. Oneil Roper, is a doctoral student of the Sheffield Hallam University, England. He has been granted permission by the Ministry of Education to conduct a research on eleventh grade students in your institution entitled "**Building Condition, Student Achievement and Behaviour in Jamaican High Schools**".

Please extend to him the necessary courtesy that will facilitate the research. Attached is the permission letter from the Ministry.

Grateful for your usual support.

Sincerely yours,

Grace McLean (Mrs.)
Chief Education Officer

Copy: Mr. Clement Radcliffe, Deputy Chief Education Officer, Schools' Operations

Attach.

Every Child Can Learn...Every Child Must Learn

• Honourable Andrew Holness, **Minister** • Mrs. Audrey Sewell, **Permanent Secretary**

Appendix H: Cover Letter for Modified CAPE

O'Neil Ryan Roper
University of Technology Jamaica
Townhouse #2
237 Old Hope Road
Kingston 6

MAY 17, 2010

Dear Principal,

I am a Sheffield Hallam University student, pursuing a Doctor of Business Administration (DBA), in the Faculty of Organization and Management, specializing in Facilities Management. (Please see attached letter of introduction). My research is focused on Jamaican High Schools and will investigate the extent to which the condition of the school's physical facilities influences learning and student behaviour at the secondary level.

This data will be handled confidentially and used for the purposes of completing the study only. All Jamaican Technical and High Schools have been included in the survey. Please complete the enclosed survey "**ASSESSMENT OF BUILDING AND CLASSROOM CONDITIONS IN JAMAICAN HIGH SCHOOLS**" and return it in the preaddressed/stamped envelope provided, preferably within two weeks of receipt.

I may be contacted at telephone numbers 995-4635/296-4957 or 927-1680-8 at extension 2450-2 or by email address oroper@utech.edu.jm if any clarifications are needed. Thank you for your willingness to participate.

Yours sincerely,

O'Neil Ryan Roper

Attch.

Appendix I: Coding for Noise-Generating Activities

Table I1

Coding for Noise-Generating Activities

Variables	Code
Close Proximity of Airport	
Close	1
Not close	2
Heavy Vehicular Traffic	
Close	1
Not close	2
Close Proximity of Railway Track	
Close	1
Not close	2
Construction Activities	
Close	1
Not close	2
Wood or Metal Workshop	
Close	1
Not close	2
Sport or Community complex	
Close	1
Not close	2

Appendix J: Coding for Structural and Cosmetic Variables

Table J1

Coding for Structural and Cosmetic Variables

Variables	Code number
Building Age	
Under 20 years	1
21 - 40 years	2
41-60 years	3
61-80 years	4
81 - 100 years	5
101 - 120 years	6
121 -140 years	7
Window Presence	
Windows are less than 1/4 of classrooms	1
Windows are in at least 1/4 of classrooms	2
Windows are in at least 3/4 of classrooms	3
Window Condition	1
Yes, they are in terrible condition	2
Yes, they are in poor condition	3
Not sure	4
No, they are in good condition	5
No, they are in excellent condition	6
Quality of Light	
Yes, they are terrible	1
Yes, they are poor	2
Not sure	3
No, they are good	4
No, they are excellent	5

Variables	Code number
Temperature of Classroom	
Yes, they are unbearably hot most of the times	1
Yes, they are hot sometimes	2
Not sure	3
No, they are not hot most times	4
No, they are cool at all times	5
Painting Schedule	
Over 15 years	1
Between 8 and 15 years	2
Less than 8 years	3
Condition Interior Wall	
Yes, they are in terrible condition	1
Yes, they are in poor condition	2
Not sure	3
No, they are in good condition	4
No, they are in excellent condition	5
Condition of Exterior Wall	
Yes, they are in terrible condition	1
Yes, they are in poor condition	2
Not sure	3
No, they are in good condition	4
No, they are in excellent condition	5

Variables	Code number
Condition of Ceiling	
Yes, they are in terrible condition	1
Yes, they are in poor condition	2
Not sure	3
No, they are in good condition	4
No, they are in excellent condition	5
Classroom Cleaning Schedule	
They are cleaned three times a day	1
They are cleaned twice a day	2
They are cleaned once a day	3
They are cleaned every week	4
Other, please specify	5
Bathroom Adequacy	
Yes, bathrooms are adequate	1
No, bathroom are not adequate	2
Don't know	3
Bathroom Condition	
Yes, they are in terrible condition	1
Yes, they are in poor condition	2
Not sure	3
No, they are in good condition	4
No, they are in excellent condition	5

Variables	Code number
Bathroom Cleaning Schedule	
They are cleaned hourly	1
They are cleaned three times a day	2
They are cleaned once a day	3
They are cleaned weekly	4
Other, please specify	5
Presence of Graffiti	
Graffiti is commonly found	1
Graffiti is sometimes found	2
Graffiti is rarely found	3
Graffiti is never found	4
Not sure	5
Condition of Classroom Furniture	
Most rooms have furniture that is either scarred or functionally damaged	1
At least half of the rooms have furniture with some minor facial scars	2
All the classrooms have furniture which is functionally sound and attractive	3
Condition of School Grounds	
There is no landscaping, and sidewalks are either not presence or damaged	1
There is no landscaping, and sidewalks are present and in good repair	2
The landscaping and other outside facilities are attractive and well ned	3
Color of Classroom Walls	
Dark colors	1
White	2
Pastel colors	3
Other, please specify	4

Appendix K: Summary of Statistical Techniques

1. Descriptive Statistics

Descriptive statistics methods were used to describe the characteristics of the sample in this thesis. Variables were also checked for any violation of the assumptions underlying the statistical techniques that were used to address the research questions (Pallant, 2007). Bastic & Matalon (2004) stated that employing the technique of descriptive statistics will describe or characterize the data obtained and give a summary of certain aspects of the results so that they can be easily understood by the reader. Keller (2005) also posited that descriptive statistics deals with methods of organizing, summarizing, and presenting data in a convenient and informative way, using graphical techniques which allow statistics practitioners to present data in ways that make it easy for the reader to extract useful information.

2. Spearman's Rank Order Correlation (rho)

Spearman's rho is a statistical test that shows the *strength* and *direction* of relationship between two continuous variables that are arranged in rank order (Pallant, 2001). Spearman's rho is a non-parametric statistical test, that is to say, it is designed to be used when data are not normally distributed, and is based on the ranks of data if there are no ties (Vogt, 1999). Values of Spearman's rho range from –1.00 to 1.00, where

- 0 indicates no relationship;
- 1 indicates a perfect positive relationship; and,
- –1.0 indicates a perfect negative relationship (Pallant, 2001).

Statistically significant relationships were those for which $p < .05$. Interpretation of the test statistic was based on the guidelines provided by Cohen (1988), where correlations of

- 0.29 (or –0.01 to –0.29) indicates a weak relationship;
- 0.30 to 0.49 (or –0.30 to –0.49) indicates a moderate relationship; and,
- 0.50 to 1.0 (or –0.50 to –1.0) indicates a strong relationship.

3. Mann-Whitney *U* Test

The Mann-Whitney *U* test is a statistical test that is used to identify significant differences between two groups (Vogt, 1999). Like Spearman's rho, the Mann-Whitney *U* Test is a non-parametric statistic. It is used when data for two groups are measured on an ordinal scale (Vogt, 1999). The test works by looking at differences in the ranked positions of scores in the two groups, the group with lowest mean ranking being the one with the greatest number of lower scores. Conversely, the group with highest mean ranking is the one with the greatest number of higher scores. The Mann-Whitney *U* Test can therefore be used to determine which group had significantly higher scores, where $p < .05$ (Field, 2000).

3. Kruskal-Wallis Test

The Kruskal-Wallis test is a statistical test that is used to identify significant differences between more than two groups (Vogt, 1999). The Kruskal-Wallis test is an extension of the Mann-Whitney *U* Test (see above). As with the Mann-Whitney *U* Test, scores are converted to ranks and the mean rank for each group is compared (Pallant, 2001).

4. Multivariate Analysis of Variance

Multivariate analysis of variance (MANOVA) is an extension of analysis of variance for use when you have more dependent variables. The dependent variables should be related in some way, or there should be some conceptual reason for considering them together (Pallant, 2001).

Appendix L: Kruskal-Wallis (83) Mann–Whitney Test

Table L1

Kruskal-Wallis (83) Mann-Whitney Test

Variables	English	POA	POB	Social studies	Mathematics	Visual arts
Building Age	.000*	.000*	.021*	.000*	.015*	.938
Window Presence	.602	.519	.185	.392	.717	.331
Window Condition	.268	.060*	.391	.148	.630	.152
Quality of Light	.360	.941	.834	.779	.515	.643
Temperature of Classroom	.129	.154	.195	.420	.236	.878
Painting Schedule	.733	.836	.826	.678	.689	.533
Condition Interior Wall	.566	.506	.479	.559	.881	.353
Condition of Exterior Wall	.566	.506	.479	.559	.881	.353
Condition of Ceiling	.696	.748	.866	.618	.796	.701
Classroom Cleaning Schedule	.237	.160	.436	.589	.239	.762
Bathroom Adequacy						
Bathroom Condition	.100	.172	.606	.147	.459	.562
Bathroom Cleaning Schedule						
Presence of Graffiti	.047*	.012*	.296	.042*	.036*	.468
Condition of Classroom Furniture	.011*	.039*	.216	.150	.060*	.324
Condition of School Grounds	.074*	.449	.559	.049*	.209	.747
Color of Classroom Walls	.788	.381	.966	.544	.416	.345

Appendix M: Kruskal-Wallis (57) Mann–Whitney Test

Table M1

Kruskal-Wallis (57) Mann-Whitney Test

Variables	English	POA	POB	Social studies	Mathematics	Visual arts
Building Age	.007*	.026*	.068*	.023*	.012*	.826
Window Presence	.484	.420	.328	.328	.856	.557
Window Condition	.316	.107	.485	.253	.573	.237
Quality of Light	.378	.426	.450	.314	.693	.323
Temperature of Classroom	.471	.574	.574	.574	.483	.561
Painting Schedule	.943	.442	.915	.543	.985	.437
Condition Interior Wall	.858	.600	.729	.955	.892	.319
Condition of Exterior Wall	.792	.863	.927	.863	.562	.918
Condition of Ceiling	.576	.844	.955	.463	.768	.172
Classroom Cleaning Schedule	.242	.241	.348	.465	.493	.493
Bathroom Adequacy	.802	.177	.472	.653	.295	.797
Bathroom Condition	.130	.355	.479	.089	.575	.369
Bathroom Cleaning Schedule						
Presence of Graffiti	.556	.313	.489	.520	.353	.986
Condition of Classroom Furniture	.117	.246	.271	.039*	.113	.838
Condition of School Grounds	.202	.788	.923	.212	.521	.715
Color of Classroom Walls	.686	.709	.563	.918	.442	.581

Appendix N: Kruskal-Wallis Test Results for Four Subjects

Table N1

Seven Groups of School Ages and their Associated Mean Rank And Median For Principles of Accounts

Building age	N	Mean Rank	Median
Under 20 years	7	26.29	33.30
21-20 years	33	34.53	49.20
41-60 years	24	45.25	63.80
61- 80 years	8	56.56	81.50
81 – 100 years	5	63.40	89.10
101 – 120 years	4	56.75	72.90
121-140 years	2	40.00	45.85
Total	83		63.70

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the seven groups.

Table N2

Seven Groups of School Ages and their Associated Mean Rank and Median for Principles of Business

Building age	N	Mean Rank	Median
Under 20 years	7	21.36	50.00
21-20 years	33	32.71	73.90
41-60 years	24	45.23	87.25
61- 80 years	8	63.63	97.40
81 – 100 years	5	61.00	95.80
101 – 120 years	4	52.63	91.90
121-140 years	2	73.50	97.85
Total	83		85.40

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the seven groups.

Table N3

Seven Groups of School Ages and their Associated Mean Rank and Median for Social Studies

Building age	N	Mean Rank	Median
Under 20 years	7	36.57	78.70
21-20 years	33	30.59	69.05
41-60 years	24	45.26	86.80
61- 80 years	8	53.38	92.80
81 – 100 years	5	64.10	97.00
101 – 120 years	4	44.25	83.60
121-140 years	2	60.25	93.55
Total	83		82.20

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the seven groups.

Table N4

Seven Groups of School Ages and their Associated Mean Rank and Median for Visual Arts

Building age	N	Mean Rank	Median
Under 20 years	7	36.79	66.70
21-20 years	33	38.35	72.20
41-60 years	24	39.83	86.70
61- 80 years	8	43.81	86.25
81 – 100 years	5	46.80	88.20
101 – 120 years	4	49.63	89.30
121-140 years	2	47.25	80.35
Total	83		84.60

Kruskal-Wallis Test revealed a statistically significant difference in Visual Arts scores across the seven groups.

Appendix O: Other Kruskal-Wallis Test Results

Table O1

Kruskal –Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	31.52	25.717	14.96	24.21	15.72	1.79
Df	6	6	6	6	6	6
Significance	.000	.000	.021	.000	.015	.938

Note. $p < .10$.

Table O2

Three Groups of Schools with their Presence of Windows and their Mean Rank and Median for English Language

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	31.92	46.50
At least ¼ of classrooms	20	42.15	62.60
At least ¾ of classrooms	51	38.360	53.80
Missing answer	6		90.60
Total	83		59.45

Kruskal-Wallis Test revealed a statistically significant difference in English Language scores across the three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p = .014. Group 2 recorded the highest median score (Md=62.60) than the other two ages.

Table O3

Three Groups of Schools with their Presence of Windows and their Associated Mean Rank and Median for Mathematics

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	29.00	24.15
At least ¼ of classrooms	20	40.28	27.50
At least ¾ of classrooms	51	39.68	31.30
Missing answer	6		69.50
Total	83		32.50

Kruskal-Wallis Test revealed a statistically significant difference in Mathematics scores across three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p= .014. Group 3 recorded the highest median score (Md=31.30) than the other two ages.

Table O4

Three Groups of Schools with their Presence of Windows and their Associated Mean Rank and Median for Principles of Accounts

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	26.92	48.690
At least ¼ of classrooms	20	34.88	49.60
At least ¾ of classrooms	51	42.04	63.90
Missing answer	6		91.70
Total	83		63.70

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p = .014. Group 3 recorded the highest median score (Md=63.90) than the other two ages.

Table O5

Three Groups of Schools with their Presence of Windows and their Associated Mean Rank and Median for Principles of Business

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	27.25	66.10
At least ¼ of classrooms	20	41.18	84.00
At least ¾ of classrooms	51	39.53	85.40
Missing answer	6		95.58
Total	83		85.30

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p = .014. Group 3 recorded the highest median score (Md=85.40) than the other two ages.

Table O6

Three Groups of Schools with their Presence of Windows and their Associated Mean Rank and Median for Social Studies

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	33.50	76.05
At least ¼ of classrooms	20	40.95	85.60
At least ¾ of classrooms	49	37.35	80.90
Missing answer	8		92.10
Total	83		82.30

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p = .014. Group 2 recorded the highest median score (Md=85.60) than the other two ages.

Table O7

Three Groups of Schools with their Presence of Windows and their Associated Mean Rank and Median for Visual Arts

Window Size	N	Mean Rank	Median
Less than ¼ of classrooms	6	41.92	82.60
At least ¼ of classrooms	20	42.70	88.05
At least ¾ of classrooms	48	34.78	82.60
Missing answer	9		84.40
Total	83		84.60

Kruskal-Wallis Test revealed a statistically significant difference in Visual Arts scores across the three groups. Group 3, n = 51: At least ¾ of classrooms have windows, x2(2,n=83) = 8.57, p = .014. Group 2 recorded the highest median score (Md=88.05) than the other two ages.

Table O8

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	1.02	1.31	3.31	1.87	.666	2.21
Df	2	2	2	2	2	2
Significance	.602	.519	.185	.392	.717	.331

Table O9

Five Groups of School Window Conditions and their Associated Mean Rank and Median for English Language

Window Condition	N	Mean Rank	Median
Terrible condition	2	32.00	47.35
Poor condition	15	31.97	41.50
Not sure	2	23.00	38.60
Good condition	61	43.80	60.00
Excellent condition	1	60.00	76.10
Missing answer	2		48.60
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent window condition has a higher median score (Md=76.10) than the other four groups.

Table O10

Five Groups of School Window Conditions and their Associated Mean Rank and Median for Mathematics

Window Condition	N	Mean Rank	Median
Terrible condition	2	17.00	14.70
Poor condition	15	30.27	21.10
Not sure	2	19.25	16.75
Good condition	61	44.88	34.80
Excellent condition	1	57.00	46.70
Missing answer	2		33.20
Total	83		32.20

Kruskal-Wallis Test revealed a statistically significant difference in Mathematics scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent window condition has a higher median score (Md=46.70) than the other four groups.

Table O11

Five Groups of School Window Conditions and their Associated Mean Rank and Median for Principles of Accounts

Window Condition	N	Mean Rank	Median
Terrible condition	2	38.50	53.20
Poor condition	15	34.30	50.00
Not sure	2	20.25	38.95
Good condition	61	43.69	64.30
Excellent condition	2	24.00	41.00
Missing answer	2		49.15
Total	83		63.70

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has good window condition has a higher median score (Md=64.30) than the other four groups.

Table O12

Five Groups of School Window Conditions and their Associated Mean Rank and Median for Principles of Business

Window Condition	N	Mean Rank	Median
Terrible condition	2	33.00	72.80
Poor condition	15	31.23	73.20
Not sure	2	16.00	57.55
Good condition	61	44.66	87.90
Excellent condition	1	30.00	76.70
Missing answer	2		54.75
Total	83		85.40

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has good window condition has a higher median score (Md=87.90) than the other four groups.

Table O13

Five Groups of School Window Conditions and their Associated Mean Rank and Median for Social Studies

Window Condition	N	Mean Rank	Median
Terrible condition	2	35.50	77.80
Poor condition	15	37.46	82.30
Not sure	2	18.75	64.00
Good condition	61	41.19	81.95
Excellent condition	1	55.50	92.10
Missing answer	4		85.85
Total	83		82.20

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent window condition has a higher median score (Md=92.10) than the other four groups.

Table O14

Five Groups of School Window Conditions and their Associated Mean Rank and Median for Visual Arts

Window Condition	N	Mean Rank	Median
Terrible condition	2	71.00	100.00
Poor condition	14	30.21	69.05
Not sure	2	34.75	71.05
Good condition	59	40.62	84.60
Excellent condition	1	50.00	89.50
Missing answer	5		50.00
Total	83		84.60

Kruskal-Wallis Test revealed a statistically significant difference in Visual Arts scores across the five groups. Group5, n=1, x2 (2,n=83)=8.57,p=.014: excellent condition. The group that has terrible window condition has a higher median score (Md=100.00) than the other four groups.

Table O15

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	5.189	9.03	4.11	6.78	2.58	6.71
Df	4	4	4	4	4	4
Significance	.268	.060	.391	.148	.630	.152

Table O16

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for English Language

Lighting Quality	N	Mean Rank	Median
Terrible	1	18.00	35.10
Poor	22	38.11	46.20
Not sure			
Good	57	44.64	60.00.
Excellent	3	28.33	27.30
Missing answer			
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n=1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has good lighting quality has a higher median score (Md=60.00) than the other four groups.

Table O17

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for Mathematics

Lighting Quality	N	Mean Rank	Median
Terrible	1	45.50	33.33
Poor	22	39.43	26.30
Not sure			
Good	57	42.73	32.80
Excellent	3	45.83	40.60
Missing answer			
Total	83		32.20

Kruskal-Wallis Test revealed a statistically significant difference in Mathematics scores across the five groups. Group 5, n=1, x2 (2,n=83) = 8.57, p = .014. The group that has excellent lighting quality has a higher median score (Md=40.60) than the other four groups.

Table O18

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for Principles of Accounts

Lighting Quality	N	Mean Rank	Median
Terrible	1	31.50	50.00
Poor	22	41.57	63.80
Not sure			
Good	57	57.00	62.70
Excellent	3	3.00	33.30
Missing answer			
Total	83		63.70

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has poor lighting quality has the highest median score (Md=63.80) than the other four groups.

Table O19

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for Principles of Business

Lighting Quality	N	Mean Rank	Median
Terrible	1	21.00	66.70
Poor	22	43.02	86.45
Not sure			
Good	57	41.59	85.20
Excellent	3	49.33	95.20
Missing answer			
Total	83		85.40

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the five groups. Group 5, n=1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent lighting quality has a higher median score (Md=95.20) than the other four groups.

Table O20

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for Social Studies

Lighting Quality	N	Mean Rank	Median
Terrible	1	45.00	84.20
Poor	22	42.83	85.20
Not sure			
Good	57	39.26	78.05
Excellent	3	59.33	100.00
Missing answer			
Total	83		82.20

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the five groups. Group 5, n=1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent lighting quality has a higher median score (Md=100.00) than the other four groups.

Table O21

Five Groups of School Lighting Quality and their Associated Mean Rank and Median for Visual Arts

Lighting Quality	N	Mean Rank	Median
Terrible	1	24.50	66.70
Poor	22	42.13	87.30
Not sure			
Good	57	39.63	84.10
Excellent	3	57.00	92.20
Missing answer			
Total	83		84.60

Kruskal-Wallis Test revealed a statistically significant difference in Visual Arts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has excellent lighting quality has a higher median score (Md=92.20) than the other four groups.

Table O22

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	3.12	.399	.866	1.093	2.286	1.674
Df	3	3	3	3	3	3
Significance	.360	.941	.834	.779	.515	.643

Table O23

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for English Language

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	31.05	47.75
Hot sometimes	58	40.46	52.35
Not sure	2	73.25	92.60
Hot most times	11	50.32	69.40
Cool all the time	1	46.00	60.30
Missing answer	1		
Total	83		58.80

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: cool all the time. The group that is not sure of the temperature has a higher median score (Md=92.60) than the other four groups.

Table O24

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for Mathematics

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	27.80	18.05
Hot sometimes	58	41.75	32.50
Not sure	2	69.00	68.15
Hot most times	11	47.41	35.90
Cool all the time	1	44.00	33.00
Missing answer	1		
Total	83		32.15

Kruskal-Wallis Test revealed a statistically significant difference in Mathematics scores across the five groups. Group 5, $n = 1$, x2 $(2,n=83) = 8.57$, $p = .014$: cool all the time. The group that is not sure of the temperature has a higher median score (Md=68.15) than the other four groups.

Table O25

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for Principle of Accounts

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	37.80	53.55
Hot sometimes	58	40.16	60.25
Not sure	2	78.50	92.65
Hot most times	11	46.45	68.50
Cool all the time	1	28.00	48.10
Missing answer	1		
Total	83		63.20

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: cool all the time. The group that is not sure of the temperature has a higher median score (Md=92.65) than the other four groups.

Table O26

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for Principle of Business

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	35.90	80.30
Hot sometimes	58	41.22	85.80
Not sure	2	72.00	97.75
Hot most times	11	42.82	85.70
Cool all the time	1	38.00	82.70
Missing answer	1		
Total	83		85.30

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the five groups. Group 5, n=1, x2 (2,n=83) = 8.57, p = .014: cool all the time. The group that is not sure of the temperature has a higher median score (Md=97.75) than the other four groups.

Table O27

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for Social Studies

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	34.20	76.85
Hot sometimes	58	40.46	82.30
Not sure	2	71.50	98.05
Hot most times	11	43.05	81.50
Cool all the time	1	16.00	61.90
Missing answer	1		
Total	83		81.85

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: cool all the time. The group that is not sure of the temperature has a higher median score (Md=98.05) than the other four groups.

Table O28

Five Groups of School Classroom Temperature and their Associated Mean Rank and Median for Visual Arts

Classroom Temperature	N	Mean Rank	Median
Unbearably hot	10	40.60	79.80
Hot sometimes	58	38.85	84.45
Not sure	2	45.50	87.50
Hot most times	11	45.41	87.50
Cool all the time	1	27.00	69.20
Missing answer	4		
Total	83		84.60

Kruskal-Wallis Test revealed a statistically significant difference in Visual Arts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: cool all the time. The group that is not sure of the temperature along with the group that is hot at all times both have the highest median scores (Md=87.50) than the other three groups.

Table O29

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	7.136	6.671	6.052	3.897	5.540	1.203
Df	4	4	4	4	4	4
Significance	.129	.154	.195	.420	.236	.878

Table O30

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for English Language

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	37.33	59.60
Less than 8 years	80	42.18	58.80
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the three groups. The group between 8 and 15 year has the highest median score (Md=59.60).

Table O31

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for Mathematics

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	44.83	31.30
Less than 8 years	80	41.89	32.50
Missing	83		32.20

Kruskal- Wallis Test revealed a statistical difference in Mathematics scores across the three groups. The group less than 8 years has the highest median score (Md=32.50).

Table O32

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for Principles of Accounts

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	39.00	67.30
Less than 8 years	80	42.11	63.20
Total	83		63.70

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the three groups. The group between 8 and 15 years has the highest median score (Md=67.30).

Table O33

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for Principles of Business

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	47.67	93.10
Less than 8 years	80	41.79	85.30
Total	83		85.40

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the three groups. The group between 8 and 15 years has the highest median score (Md=93.10).

Table O34

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for Social Studies

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	35.67	87.80
Less than 8 years	80	41.21	81.85
Total	83		82.20

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the three groups. The group between 8 and 15 years has the highest median score (Md=87.80).

Table O35

Three Groups of School Painting Schedule and their Associated Mean Rank and Median for Visual Arts

Painting Schedule	N	Mean Rank	Median
Over 15 years			
Between 8 and 15 years	3	48.67	84.60
Less than 8 years	80	40.18	84.60
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the three groups. The group between 8 and 15 years and the group less than 8 years both have the highest median score (Md=84.60).

Table O36

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	.117	.043	.048	.172	.160	.388
Df	1	1	1	1	1	1
Significance	.733	.836	.826	.678	.689	.533

Table O37

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for English Language

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	23.00	41.10
Poor condition	11	33.86	46.80
Not sure	1	63.00	82.20
Good condition	64	43.06	60.15
Excellent condition	5	37.70	59.30
Missing answer	1		
Total	83		58.80

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=82.20) than the other four groups.

Table O38

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for Mathematics

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	15.00	13.60
Poor condition	11	34.59	21.10
Not sure	1	61.00	51.00
Good condition	64	43.15	32.90
Excellent condition	5	37.00	38.30
Missing answer	1		
Total	83		32.15

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, $n = 5$, x2 $(2,n=83) = 8.57$, $p = .014$: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=51.00) than the other four groups.

Table O39

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for Principles of Accounts

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	21.00	38.50
Poor condition	11	44.91	67.30
Not sure	1	65.00	81.60
Good condition	64	41.90	63.20
Excellent condition	5	28.30	41.00
Missing answer	1		
Total	83		63.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=81.60) than the other four groups.

Table O40

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for Principles of Business

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	27.00	73.20
Poor condition	11	39.27	86.20
Not sure	1	73.00	98.40
Good condition	64	42.31	85.55
Excellent condition	5	32.60	76.70
Missing answer	1		
Total	83		85.30

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=98.40) than the other four groups.

Table O41

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for Social Studies

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	21.00	67.00
Poor condition	11	39.30	84.55
Not sure	1	54.00	90.70
Good condition	64	41.02	81.50
Excellent condition	5	37.50	76.60
Missing answer	1		
Total	83		82.30

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=90.70) than the other four groups.

Table O42

Five Groups of School Internal Wall Condition and their Associated Mean Rank and Median for Visual Arts

Internal Wall Condition	N	Mean Rank	Median
Terrible condition	1	48.00	88.20
Poor condition	11	40.30	83.20
Not sure	1	71.50	100.00
Good condition	64	38.15	84.25
Excellent condition	5	54.40	93.80
Missing answer	1		
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n =5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their internal wall condition has a higher median score (Md=100.00) than the other four groups.

Table O43

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	2.95	3.32	3.49	2.99	1.18	4.41
Df	4	4	4	4	4	4
Significance	.566	.506	.479	.559	.881	.353

Table O44

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for English Language

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	23.00	41.10
Poor condition	11	33.86	46.80
Not sure	1	63.00	82.20
Good condition	64	43.06	60.15
Excellent condition	5	37.70	59.30
Missing answer	1		
Total	83		58.80

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=82.20) than the other four groups.

Table O45

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for Mathematics

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	15.00	13.60
Poor condition	11	34.59	21.10
Not sure	1	61.00	51.00
Good condition	64	43.15	32.90
Excellent condition	5	37.00	38.30
Missing answer	1		
Total	83		32.15

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=82.20) than the other four groups.

Table O46

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for Principles of Accounts

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	21.00	38.50
Poor condition	11	44.91	67.30
Not sure	1	65.00	81.60
Good condition	64	41.90	63.20
Excellent condition	5	28.30	41.00
Missing answer	1		
Total	83		63.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=81.60) than the other four groups.

Table O47

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for Principles of Business

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	27.00	73.20
Poor condition	11	39.27	86.20
Not sure	1	73.00	98.40
Good condition	64	42.31	85.55
Excellent condition	5	32.60	76.70
Missing answer	1		
Total	83		85.30

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=98.40) than the other four groups.

Table O48

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for Social Studies

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	21.00	67.00
Poor condition	11	39.30	84.55
Not sure	1	54.00	90.70
Good condition	64	41.02	81.50
Excellent condition	5	37.50	76.60
Missing answer	1		
Total	83		82.30

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, n = 5, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=90.70) than the other four groups.

Table O49

Five Groups of School External Wall Condition and their Associated Mean Rank and Median for Visual Arts

External Wall Condition	N	Mean Rank	Median
Terrible condition	1	48.00	88.20
Poor condition	11	40.30	83.20
Not sure	1	71.50	100.00
Good condition	64	38.15	84.25
Excellent condition	5	54.40	93.80
Missing answer	1		
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n = 5, x2 (2,n=83) =8.57, p = .014: excellent condition. The group that is not sure of their external wall condition has a higher median score (Md=100.00) than the other four groups.

Table O50

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	2.95	3.32	3.49	2.99	1.18	4.41
Df	4	4	4	4	4	4
Significance	.566	.506	.479	.559	.881	.353

Table O51

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for English Language

Ceiling Condition	N	Mean Rank	Median
Terrible condition	2	22.50	40.85
Poor condition	10	39.25	55.10
Not sure	1	48.00	64.10
Good condition	68	41.70	58.95
Excellent condition			
Missing answer	2		93.00
Total	83		58.80

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their ceiling condition has a higher median score (Md=64.10) than the other four groups.

Table O52

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for Mathematics

Ceiling Condition	N	Mean Rank	Median
Terrible condition	2	26.75	21.80
Poor condition	10	36.85	26.95
Not sure	1	47.00	34.60
Good condition	68	41.94	32.15
Excellent condition			
Missing answer	2		57.80
Total	83		32.15

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p =.014: excellent condition. The group that is not sure of their ceiling condition has a higher median score (Md=34.60) than the other four groups.

Table O53

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for Principles of Accounts

Ceiling Condition	N	Mean Rank	Median
Terrible condition	2	35.50	53.75
Poor condition	10	41.30	57.10
Not sure	1	59.50	77.30
Good condition	68	40.85	63.20
Excellent condition			
Missing answer	2		68.80
Total	83		63.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their ceiling condition has a higher median score (Md=77.30) than the other four groups.

Table O54

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for Principles of Business

Ceiling Condition	N	Mean Rank	Median
Terrible condition	2	20.00	62.90
Poor condition	10	40.95	84.15
Not sure	1	50.50	88.90
Good condition	68	41.49	85.30
Excellent condition			
Missing answer	2		96.30
Total	83		85.30

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that is not sure of their ceiling condition has a higher median score (Md=88.90) than the other four groups.

Table O55

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for Social Studies

Ceiling Condition	N	Mean Rank	Median
Terrible condition	1	22.00	67.00
Poor condition	10	38.15	83.70
Not sure	1	28.00	72.10
Good condition	67	40.72	81.50
Excellent condition			
Missing answer	4		96.30
Total	83		81.85

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has poor ceiling condition has a higher median score (Md=83.70) than the other four groups.

Table O56

Five Groups of School Ceiling Condition and their Associated Mean Rank and Median for Visual Arts

Ceiling Condition	N	Mean Rank	Median
Terrible condition	1	48.00	88.20
Poor condition	10	46.85	92.75
Not sure	1	41.50	85.70
Good condition	66	38.23	84.25
Excellent condition			
Missing answer	5		20.00
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group that has poor ceiling condition has a higher median score (Md=92.75) than the other four groups.

Table O57

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	1.44	1.22	.732	1.79	1.02	1.42
Df	3	3	3	3	3	3
Significance	.696	.748	.866	.618	.796	.701

Table O58

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for English Language

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	30.88	36.40
Cleaned twice a day	23	36.46	47.90
Cleaned once a day	54	44.30	60.15
Cleaned every week	1	83.00	99.50
Other, please specify	1	49.00	65.10
Missing answer			
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that cleans every week has a higher median score (Md=99.50) than the other four groups.

Table O59

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for Mathematics

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	35.75	24.35
Cleaned twice a day	23	34.26	22.50
Cleaned once a day	54	44.74	33.15
Cleaned every week	1	83.00	99.50
Other, please specify	1	56.00	42.10
Missing answer			
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that cleans every week has a higher median score (Md=99.50) than the other four groups.

Table O60

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for Principles of Accounts

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	46.63	74.80
Cleaned twice a day	23	37.80	85.70
Cleaned once a day	54	42.68	83.20
Cleaned every week	1	83.00	100.00
Other, please specify	1	42.50	88.30
Missing answer			
Total	83		85.40

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that cleans every week has a higher median score (Md=100.00) than the other four groups.

Table O61

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for Principles of Business

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	39.88	74.55
Cleaned twice a day	23	40.57	75.40
Cleaned once a day	54	41.92	83.90
Cleaned every week	1	81.00	
Other, please specify	1	49.00	91.90
Missing answer			82.20
Total	83		82.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their cleaning schedule has a higher median score (Md=91.90) than the other four groups.

Table O62

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for Social Studies

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	33.38	74.55
Cleaned twice a day	23	33.67	75.40
Cleaned once a day	54	44.47	83.90
Cleaned every week	1	56.00	
Other, please specify	1		
Missing answer	2		91.80
Total	83		82.20

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that cleans once a day has a higher median score (Md=83.90) than the other four groups.

Table O63

Five Groups of Classroom Cleaning Schedule and their Associated Mean Rank and Median for Visual Arts

Cleaning Schedule	N	Mean Rank	Median
Cleaned three times daily	4	26.00	46.20
Cleaned twice a day	23	41.41	85.70
Cleaned once a day	54	40.45	84.25
Cleaned every week	1	49.00	88.20
Other, please specify	1	57.00	
Missing answer	3		93.30
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n = 1, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that cleans every week has a higher median score (Md=88.20) than the other four groups.

Table O64

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	5.537	6.569	3.781	2.816	4.212	1.857
Df	4	4	4	4	4	4
Significance	.237	.160	.436	.589	.239	.762

Table O65

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for English Language

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	5.50	21.70
Poor condition	14	31.39	44.35
Not sure	5	52.90	90.70
Good condition	61	42.81	60.30
Excellent condition			
Missing answer	2		58.00
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group not sure of their bathroom condition has a higher median score (Md=90.70) than the other four groups.

Table O66

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for Mathematics

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	21.00	16.50
Poor condition	14	30.61	20.40
Not sure	5	52.50	69.50
Good condition	61	42.77	33.30
Excellent condition			
Missing answer	2		31.35
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group not sure of their bathroom condition has a higher median score (Md=69.50) than the other four groups.

Table O67

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for Principles of Accounts

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	69.00	85.00
Poor condition	14	39.46	57.10
Not sure	5	47.00	81.50
Good condition	61	40.40	63.70
Excellent condition			
Missing answer	2		58.75
Total	83		63.70
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group with terrible bathroom condition has a higher median score (Md=85.00) than the other four groups.

Table O68

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for Principles of Business

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	79.00	100.00
Poor condition	14	31.18	77.70
Not sure	5	44.50	93.20
Good condition	61	42.34	87.70
Excellent condition			
Missing answer	2		87.25
Total	83		85.40
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group with terrible bathroom condition has a higher median score (Md=100.00) than the other four groups.

Table O69

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for Social Studies

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	42.50	82.40
Poor condition	14	32.73	73.90
Not sure	5	51.40	95.90
Good condition	61	40.58	84.05
Excellent condition			
Missing answer	2		88.50
Total	83		82.20
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group not sure of their bathroom condition has a higher median score (Md=95.90) than the other four groups.

Table O70

Five Groups of School Bathroom Condition and their Associated Mean Rank and Median for Visual Arts

Bathroom Condition	N	Mean Rank	Median
Terrible condition	1	9.00	28.60
Poor condition	14	37.42	71.40
Not sure	5	39.00	88.20
Good condition	61	40.47	84.60
Excellent condition			
Missing answer	2		96.65
Total	83		84.60
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n = 0, x2 (2,n=83) = 8.57, p = .014: excellent condition. The group not sure of their bathroom condition has a higher median score (Md=88.20) than the other four groups.

Table O71

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	6.253	4.995	1.841	5.360	2.590	2.049
Df	3	3	3	3	3	3
Significance	.100	.172	.606	.147	.459	.562

Table O72

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for English Language

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	17.50	34.05
Cleaned twice a day	13	44.73	60.30
Cleaned once a day	44	37.84	56.05
Cleaned every week	19	44.76	65.10
Other, please specify	2	54.00	73.15
Missing answer	3		50.60
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the five groups. Group 5, n = 2, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their bathroom cleaning schedule has a higher median score (Md=73.15) than the other four groups.

Table O73

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for Mathematics

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	33.00	22.75
Cleaned twice a day	13	41.62	33.00
Cleaned once a day	44	37.68	30.00
Cleaned every week	19	45.74	35.00
Other, please specify	2	53.00	42.80
Missing answer	3		49.30
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the five groups. Group 5, n = 2, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their bathroom cleaning schedule has a higher median score (Md=42.80) than the other four groups.

Table O74

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for Principles of Accounts

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	56.50	76.80
Cleaned twice a day	13	46.38	64.30
Cleaned once a day	44	37.66	61.35
Cleaned every week	19	39.18	57.80
Other, please specify	2	61.25	79.45
Missing answer	3		56.90
Total	83		63.70

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the five groups. Group 5, n = 2, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their bathroom cleaning schedule has a higher median score (Md=79.45) than the other four groups.

Table O75

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for Principles of Business

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	31.50	80.30
Cleaned twice a day	13	39.04	82.70
Cleaned once a day	44	36.52	83.20
Cleaned every week	19	49.63	89.60
Other, please specify	2	59.75	93.65
Missing answer	3		73.90
Total	83		85.40

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the five groups. Group 5, n = 2, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their bathroom cleaning schedule has a higher median score (Md=93.65) than the other four groups.

Table O76

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for Social Studies

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	24.50	69.75
Cleaned twice a day	13	35.85	81.50
Cleaned once a day	44	37.62	79.15
Cleaned every week	19	47.63	89.50
Other, please specify	2	40.50	81.40
Missing answer	3		93.20
Total	83		82.20

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the five groups. Group 5, $n = 2$, $x2\ (2,n=83) = 8.57$, $p = .014$: other, please specify. The group that cleans everyday has a higher median score (Md=89.50) than the other four groups.

Table O77

Five Groups of School Bathroom Cleaning Schedule and their Associated Mean Rank and Median for Visual Arts

Bathroom Cleaning	N	Mean Rank	Median
Cleaned three times daily	2	15.00	48.70
Cleaned twice a day	13	43.04	86.70
Cleaned once a day	44	36.87	82.60
Cleaned every week	19	41.92	86.60
Other, please specify	2	55.25	92.85
Missing answer	3		84.40
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the five groups. Group 5, n = 2, x2 (2,n=83) = 8.57, p = .014: other, please specify. The group that didn't specify their bathroom cleaning schedule has a higher median score (Md=92.85) than the other four groups.

Table O78

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	4.281	2.429	4.096	5.949	3.956	4.503
Df	4	4	4	4	4	4
Significance	.369	.657	.393	.203	.412	.342

Table O79

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for English Language

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	30.55	45.50
Graffiti is sometimes found	45	45.57	65.10
Graffiti is rarely found	17	40.71	58.30
Graffiti is never found	1	80.00	96.50
Missing answer			22.70
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the four groups. The group that has never found graffiti has the highest median score (Md=96.50).

Table O80

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for Mathematics

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	26.66	17.60
Graffiti is sometimes found	45	45.06	34.80
Graffiti is rarely found	17	46.79	33.30
Graffiti is never found	1	73.50	83.20
Missing answer			8.110
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the four groups. The group that has never found graffiti has the highest median score (Md=83.20).

Table O81

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for Principle of Accounts

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	36.50	55.70
Graffiti is sometimes found	45	41.68	65.60
Graffiti is rarely found	17	44.35	53.10
Graffiti is never found	1	80.00	94.40
Missing answer			35.70
Total	83		63.70

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the four groups. The group that has never found graffiti has the highest median score (Md=94.40).

Table O82

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for Principle of Business

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	29.26	75.00
Graffiti is sometimes found	45	43.48	88.30
Graffiti is rarely found	17	48.21	85.70
Graffiti is never found	1	71.00	97.20
Missing answer			69.20
Total	83		85.40

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the four groups. The group that sometimes found graffiti has the highest median score (Md=88.30).

Table O83

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for Social Studies

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	28.13	67.30
Graffiti is sometimes found	45	43.59	86.10
Graffiti is rarely found	17	44.72	83.20
Graffiti is never found	1	72.00	98.60
Missing answer			43.10
Total	83		82.20

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the four groups. The group that has never found graffiti has the highest median score (Md=98.60).

Table O84

Four Groups of Graffiti Presence and their Associated Mean Rank and Median for Visual Arts

Graffiti Presence	N	Mean Rank	Median
Graffiti is commonly found	19	40.32	81.80
Graffiti is sometimes found	45	40.76	85.70
Graffiti is rarely found	17	35.63	76.65
Graffiti is never found	1	71.50	100.00
Missing answer			50.00
Total	83		84.60

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the four groups. The group that has never found graffiti has the highest median score (Md=100.00).

Table O85

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	7.96	11.029	3.698	8.211	8.529	2.538
Df	3	3	3	3	3	3
Significance	.047	.012	.296	.042	.036	.468

Table O86

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for English Language

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	25.73	40.60
Half of the rooms have furniture with minor facial scars	56	40.70	58.95
Furniture sound and attractive	14	54.21	84.20
Missing answer	2		52.45
Total	83		59.30

Kruskal-Wallis Test revealed a statistically significant difference in English Language scores across the three groups. The group that has sound and attractive furniture has the highest median score (Md=84.20.

Table O87

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for Mathematics

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	30.91	23.00
Half of the rooms have furniture with minor facial scars	56	39.72	32.15
Furniture sound and attractive	14	54.04	59.60
Missing answer	2		29.55
Total	83		32.20

Kruskal-Wallis Test revealed a statistically significant difference in Mathematics scores across the three groups. The group that has sound and attractive furniture has the highest median score (Md=59.60).

Table O88

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for Principles of Accounts

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	37.23	55.70
Half of the rooms have furniture with minor facial scars	56	39.27	61.35
Furniture sound and attractive	14	50.89	78.00
Missing answer	2		58.65
Total	83		63.70

Kruskal- Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the three groups. The group that has sound and attractive furniture has the highest median score (Md=78.00).

Table O89

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for Principles of Business

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	29.68	69.40
Half of the rooms have furniture with minor facial scars	56	41.48	85.55
Furniture sound and attractive	14	47.96	90.30
Missing answer	2		83.80
Total	83		85.40

Kruskal-Wallis Test revealed a statistically significant difference in Principles of Business scores across the three groups. The group that has sound and attractive furniture has the highest median score (Md=90.30).

Table O90

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for Social Studies

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	24.70	68.95
Half of the rooms have furniture with minor facial scars	56	41.21	82.40
Furniture sound and attractive	14	46.18	89.65
Missing answer	2		66.90
Total	83		82.20

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the three groups. The group that has sound and attractive furniture has the highest median score (Md=89.65).

Table O91

Three Groups of Condition of Classroom Furniture and their Associated Mean Rank and Median for Visual Arts

Furniture Condition	N	Mean Rank	Median
Furniture is either scarred or functionally damaged	11	29.28	57.10
Half of the rooms have furniture with minor facial scars	56	41.40	87.50
Furniture sound and attractive	14	38.61	83.10
Missing answer	2		
Total	83		84.60

Kruskal- Wallis Test revealed a statistically significant difference in Visual Arts scores across the three groups. The group with half of the room having minor facial scare has the highest median score (Md=87.50).

Table O92

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	9.063	6.487	3.062	3.797	5.614	2.257
Df	2	2	2	2	2	2
Significance	.011	.039	.216	.150	.060	.324

Table O93

Three Groups of Grounds Condition and their Associated Mean Rank and Median for English Language

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	25.20	26.20
No landscape and sidewalks present	18	35.64	49.70
Landscape and sidewalks are attractive	59	44.67	63.80
Missing answer	1		
Total	83		59.45

Kruskal-Wallis Test revealed a statistically significant difference in English Language scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=63.80).

Table O94

Three Groups of Grounds Condition and their Associated Mean Rank and Median for Mathematics

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	34.10	30.00
No landscape and sidewalks present	18	36.86	27.60
Landscape and sidewalks are attractive	59	43.54	33.00
Missing answer	1		32.15
Total	83		

Kruskal- Wallis Test revealed a statistically significant difference in Mathematics scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=33.00).

Table O95

Three Groups of Grounds Condition and their Associated Mean Rank and Median for Principles of Accounts

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	36.90	49.20
No landscape and sidewalks present	18	36.97	55.35
Landscape and sidewalks are attractive	59	43.27	65.60
Missing answer	1		
Total	83		63.70

Kruskal- Wallis Test revealed a statistically significant difference in Principles of Accounts scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=65.60).

Table O96

Three Groups of Grounds Condition and their Associated Mean Rank and Median for Principles of Business

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	23.00	52.60
No landscape and sidewalks present	18	34.44	84.75
Landscape and sidewalks are attractive	59	45.22	86.40
Missing answer	1		
Total	83		85.55

Kruskal- Wallis Test revealed a statistically significant difference in Principles of Business scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=86.40).

Table O97

Three Groups of Grounds Condition and their Associated Mean Rank and Median for Social Studies

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	29.13	62.40
No landscape and sidewalks present	18	33.86	73.00
Landscape and sidewalks are attractive	59	43.34	82.40
Missing answer	1		81.85
Total	83		

Kruskal-Wallis Test revealed a statistically significant difference in Social Studies scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=82.40).

Table O98

Three Groups of Grounds Condition and their Associated Mean Rank and Median for Visual Arts

Grounds Condition	N	Mean Rank	Median
Landscape and sidewalks present	5	32.00	50.00
No landscape and sidewalks present	18	42.50	72.20
Landscape and sidewalks are attractive	59	39.69	85.70
Missing answer	1		
Total	83		84.60

Kruskal- Wallis Test revealed a statistically significant difference in Visual Arts scores across the three groups. The group that has attractive landscape and sidewalks has the highest median score (Md=85.70).

Table O99

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	4.478	1.600	1.164	6.039	3.298	.582
Df	2	2	2	2	2	2
Significance	.107	.449	.559	.049	.192	.747

Table O100

Four Groups of School Wall Colour and their Associated Mean Rank and Median for English Language

School Colour	N	Mean Rank	Median
Dark colour	2	25.00	40.50
White	7	43.79	60.00
Pastel colour	43	42.02	59.30
Other	31	42.66	59.60
Missing answer			
Total	83		59.30

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the four groups. The group that has white walls has the highest median score (Md=60.00).

Table O101

Four Groups of School Wall Colour and their Associated Mean Rank and Median for Mathematics

School Colour	N	Mean Rank	Median
Dark colour	2	19.00	14.75
White	7	37.93	33.00
Pastel colour	43	45.29	34.70
Other	31	39.84	30.00
Missing answer			
Total	83		32.20

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the four groups. The group that has pastel colour walls has the highest median score (Md=34.70).

Table O102

Four Groups of School Wall Colour and their Associated Mean Rank and Median for Principles of Accounts

School Colour	N	Mean Rank	Median
Dark colour	2	33.50	49.80
White	7	43.14	62.70
Pastel colour	43	42.19	57.80
Other	31	42.03	65.60
Missing answer			63.70
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the four groups. The group that has other colour walls has the highest median score (Md=65.60).

Table O103

Four Groups of School Wall Colour and their Associated Mean Rank and Median for Principles of Business

School Colour	N	Mean Rank	Median
Dark colour	2	21.75	64.30
White	7	46.93	83.30
Pastel colour	43	40.51	85.40
Other	31	44.26	86.70
Missing answer			
Total	83		85.40

Kruskal-Wallis Test revealed a statistical difference in Principles of Business scores across the four groups. The group with other wall colours has the highest median score (Md=86.70).

Table O104

Four Groups of School Wall Colour and their Associated Mean Rank and Median for Social Studies

School Colour	N	Mean Rank	Median
Dark colour	2	28.25	71.60
White	7	38.71	74.60
Pastel colour	43	45.01	86.10
Other	31	36.77	76.65
Missing answer			82.20
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Social Studies scores across the four groups. The group that has pastel colour walls has the highest median score (Md=86.10).

Table O105

Four Groups of School Wall Colour and their Associated Mean Rank and Median for Visual Arts

School Colour	N	Mean Rank	Median
Dark colour	2	20.50	58.35
White	7	30.00	69.20
Pastel colour	43	42.60	87.50
Other	31	41.42	85.15
Missing answer			84.60
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Visual Arts scores across the four groups. The group that has pastel colour walls has the highest median score (Md=87.50).

Table O106

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	1.057	3.072	.267	2.141	2.847	3.319
Df	3	3	3	3	3	3
Significance	.788	.381	.966	.544	.416	.345

Table O107

Three Groups of School Ages and their Associated Mean Rank and Median for English Language

Building Age	N	Mean Rank	Median
New schools	7	13.93	
Average age	56	38.31	
Old	20	62.15	
Total	83		

Kruskal-Wallis Test revealed a statistical difference in English Language scores across the three groups. The group with old age has the highest median score (Md=62.15).

Table O108

Three Groups of School Ages and their Associated Mean Rank and Median for Mathematics

Building Age	N	Mean Rank	Median
New schools	7	27.00	
Average age	56	36.36	
Old	20	63.05	
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Mathematics scores across the three groups. The group with old age has the highest median score (Md=63.05).

Table O109

Three Groups of School Ages and their Associated Mean Rank and Median for Principles of Accounts

Building Age	N	Mean Rank	Median
New schools	7	26.29	
Average age	56	39.29	
Old	20	55.08	
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Principles of Accounts scores across the three groups. The group with old age has the highest median score (Md=55.08).

Table O110

Three Groups of School Ages and their Associated Mean Rank and Median for Principles of Business

Building Age	N	Mean Rank	Median
New schools	7	21.36	
Average age	56	38.11	
Old	20	60.13	
Total	83		

Kruskal- Wallis Test revealed a statistical difference in Principles of Business scores across the three groups. The group with old age has the highest median score (Md=60.13).

Table O111

Three Groups of School Ages and their Associated Mean Rank and Median for Social Studies

Building Age	N	Mean Rank	Median
New schools	7	36.57	
Average age	56	36.34	
Old	20	55.13	
Total	83		

Kruskal- Wallis Test revealed a statistical difference in Social Studies scores across the three groups. The group with old age has the highest median score (Md=55.13).

Table O112

Three Groups of School Ages and their Associated Mean Rank and Median for Visual Arts

Building Age	N	Mean Rank	Median
New schools	7	36.79	
Average age	56	38.75	
Old	20	46.43	
Total	83		

Kruskal-Wallis Test revealed a statistical difference in Principle of Accounts scores across the three groups. The group with old age has the highest median score (Md=46.43).

Table O113

Kruskal–Wallis and Group Variables for Six Academic Subjects

	English	Mathematics	POA	POB	Social Studies	Visual Arts
Chi- Square	24.784	21.034	9.567	17.908	9.577	1.793
Df	2	2	2	2	2	2
Significance	.000	.000	.000	.000	.008	.408

Table O114

Three Groups of Bathroom Adequacy their Associated Mean Rank for English Language

Bathroom Adequacy	N	Mean Rank - English Language
Yes, bathroom adequate	48	42.17
No, bathroom not adequate	32	40.41
Don't know	3	43.00
Total	83	

Table O115

Three Groups of Bathroom Adequacy their Associated Mean Rank for Mathematics

Bathroom Adequacy	N	Mean Rank - Mathematics
Yes, bathroom adequate	48	45.59
No, bathroom not adequate	32	35.48
Don't know	3	39.50
Total	83	

Table O116

Three Groups of Bathroom Adequacy their Associated Mean Rank for Principles of Accounts

Bathroom Adequacy	N	Mean Rank - Principles of Accounts
Yes, bathroom adequate	48	41.98
No, bathroom not adequate	32	41.22
Don't know	3	34.5
Total	83	

Table O117

Three Groups of Bathroom Adequacy their Associated Mean Rank for Principles of Business

Bathroom Adequacy	N	Mean Rank - Principles of Business
Yes, bathroom adequate	48	42.27
No, bathroom not adequate	32	41.02
Don't know	3	30.75
Total	83	

Table O118

Three Groups of Bathroom Adequacy their Associated Mean Rank for Social Studies

Bathroom Adequacy	N	Mean Rank - Social Studies
Yes, bathroom adequate	48	40.65
No, bathroom not adequate	32	40.18
Don't know	3	42.00
Total	83	

Table O119

Three Groups of Bathroom Adequacy their Associated Mean Rank for Visual Arts

Bathroom Adequacy	N	Mean Rank - Visual Arts
Yes, bathroom adequate	48	39.79
No, bathroom not adequate	32	41.19
Don't know	3	13.00
Total	83	

Appendix P: Mann-Whitney U Test – Schools in Close Proximity of Noise-Generating Activities

Table P1

Mann-Whitney U Test – Schools in Close Proximity of Airport

Proximity of Airport to School	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Mann–Whitney U	47.500	51.000	55.000	49.000	76.000	74.000
Z	-.935	-.891	-.772	-.950	-.091	-.124
Asymp. sig	.382	.413	.477	.382	.939	.914

The Mann–Whitney U test revealed no significant difference in school's academic scores of schools in close proximity of airport for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Table P2

Mann-Whitney U Test - Heavy Vehicular Traffic

Heavy Vehicular Traffic	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Mann–Whitney U	654.500	648.000	848.500	756.500	664.500	749.500
Z	-1.873	-1.932	-.105	-.943	-1.443	-.469
Asymp. sig	.061	.053	.917	.345	.149	.639

The Mann–Whitney U test revealed no significant difference in school's academic scores of schools in close proximity of heavy vehicular traffic and schools not in close proximity for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Table P3

Mann-Whitney U Test – Close Proximity of Operational Railway Track

Close Proximity of Operational Railwa Track	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Mann–Whitney U	46.000	36.000	58.000	51.500	13.000	34.000
Z	-1.039	-1.336	-.683	-.876	-2.009	-1.362
Asymp. sig	.339	.212	.529	.413	.035	.205

The Mann–Whitney U test revealed no significant difference in school's academic scores of schools in close proximity of operational railway track and schools not in close proximity for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Table P4

Mann-Whitney U Test - Presence of Construction Activities

Presence of Constructioı Activities	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Mann–Whitney U	116.000	92.000	96.500	90.500	90.500	147.000
Z	-1.512	-1.971	-1.885	-2.000	-1.953	-.808
Asymp. sig	.136	.048	.058	.043	.049	.438

The Mann–Whitney U test revealed no significant difference in school's academic scores of schools in the presence of construction activities and schools not in close proximity for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Table P5

Mann-Whitney U Test - Presence of Wood and Metal Workshops

Presence of Wood and Metal Workshops	**English Language**	**Mathematics**	**POA**	**POB**	**Social Studies**	**Visual Arts**
Mann–Whitney U	507.500	575.500	543.000	515.000	546.500	521.000
Z	-3.066	-2.439	-2.739	-2.997	-2.417	-2.498
Asymp. sig	.002	.015	.006	.003	.016	.012

The Mann–Whitney U test revealed no significant difference in school's academic scores of schools in the presence of wood and metal workshops and schools not in close proximity for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Table P6

Mann-Whitney U Test – Close Proximity of Sport or Community Complex

Close Proximity of Sport or Community Complex	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Mann–Whitney U	714.000	723.000	768.000	787.500	610.500	573.000
Z	-1.033	-.949	-.530	-.349	-1.745	-1.988
Asymp. sig	.302	.343	.596	.727	.081	.047

The Mann–Whitney U test revealed no significant difference in school's academic scores of in close proximity of sport or community complex and schools not in close proximity for any of the six academic subjects – English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts.

Appendix Q: Mann –Whitney (83) – Schools in Close Proximity of Noise-Generating Activities

Table Q1

Mann-Whitney (83) – Schools in Close Proximity of Noise-Generating Activities

Variables	English	POA	POB	Social Studies	Mathematics	Visual Arts
Close Proximity of Airport	.382	.413	.477	.382	.939	.914
Heavy Vehicular Traffic	.061*	.053*	.917	.345	.149	.639
Close Proximity of Railway Track	.339	.105*	.702	.281	.037*	.704
Construction Activities	.136	.048*	.058*	.058*	.043*	.049*
Wood or Metal Workshop	.002*	.015*	.006*	.003*	.016*	.012*
Sport or Community complex	.302*	.343	.596	.727	.081*	.047*

Appendix R: Mann –Whitney (57) – Schools in Close Proximity of Noise-Generating Activities

Table R1

Mann-Whitney (57) – Schools in Close Proximity of Noise-Generating Activities

Variables	English	POA	POB	Social Studies	Mathematics	Visual Arts
Close Proximity of Airport	.807	.772	.737	.982	.444	.741
Heavy Vehicular Traffic	.303	.102*	.924	.411	.078*	.848
Close Proximity of Railway Track	.421	.105*	.702	.281	.037*	.704
Construction Activities	.775	.775	.179	.551	.565	.662
Wood or Metal Workshop	.046*	.120	.034*	.056*	.102*	.104
Sport or Community complex	.670	.803	.552	.828	.180	.101*

Appendix S: Multivariate Analysis – Wilks' Lambda (83) – Noise Generating Activities

Table S1

Multivariate Analysis – Wilk's Lambda (83) – Noise-Generating Activities

Variables	English
Close Proximity of Airport	.617
Heavy Vehicular Traffic	.027*
Close Proximity of Railway Track	.362
Construction Activities	.407
Wood or Metal Workshop	.248
Sport or Community complex	.043*

Appendix T: Median for Groups of Noise Generating Activities

Table T1

Median for Two Groups of Noise Generating Activities – Schools in Close Proximity of Airport

Close Proximity of Airport to School	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	75.50	51.25	71.40	91.05	79.45	78.70
No -Median	81	58.30	32.10	63.70	85.40	82.20	84.60
Total	83	59.30	32.20	63.70	85.40	82.20	84.60

Table T2

Median for Two Groups of Noise Generating Activities - Heavy Vehicular Traffic

Heavy Vehicular Traffic	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	65.20	35.00	62.70	87.70	88.50	85.65
No -Median	81	47.40	22.70	63.80	83.20	77.05	83.25
Total	83	59.30	32.20	63.70	85.40	82.20	84.60

Table T3

Median for Two Groups of Noise Generating Activities - Proximity of Operational Railway Track

Close Proximity of Operational Railw: Track	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	38.20	15.65	49.05	67.8 5	47.85	51.75
No -Median	81	59.60	32.80	63.70	85.4 0	88.40	85.15
Total	83	59.30	32.20	63.70	85.4 0	82.20	84.60

Table T4

Median for Two Groups of Noise Generating Activities - Presence of Construction Activities

Presence of Construction Activities	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	41.40	13.60	38.50	69.40	61.90	69.20
No -Median	81	59.45	33.05	64.10	86.30	82.40	84.60
Total	83	59.30	32.20	63.70	85.40	82.20	84.60

Table T5

Median for Two Groups of Noise Generating Activities- Presence of Wood and Metal Workshops

Presence of Wood and Metal Workshops	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	46.90	22.40	50.0 0	80.40	73.35	70.00
No -Median	81	69.00	35.45	68.65	91.95	88.50	88.20
Total	83	59.30	32.20	63.70	85.40	82.20	84.60

Table T6

Median for Two Groups of Noise Generating Activities - Proximity of Sport or Community Complex

Close Proximity of Sport or Community Complex	N	English Language	Mathematics	POA	POB	Social Studies	Visual Arts
Yes- Median	2	48.80	32.80	63.70	85.20	76.60	70.00
No -Median	81	59.45	32.15	61.85	86.30	84.55	87.90
Total	83	59.30	32.20	63.70	85.40	82.20	84.60

Appendix U: Multivariate Analysis for Cosmetic Variables

Window presence. A one–way between–groups multivariate analysis of variance was performed to investigate window presence differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was presence of windows. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity; no serious violations were noted. There was no significant difference among the seven age groups on the combined dependent variables, $F(18,28.77) = 1.11$, $p = .388$: Wilk's Lambda = .244: partial eta square .393.

Adequacy of lighting. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was adequacy of lighting. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the four groups on the combined dependent variables, $F(12,20) = 1.786$, $p = .121$: Wilk's Lambda = .233: partial eta square .517.

Window condition. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was window condition. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance, covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the seven age groups on the combined dependent variables, $F(30,42) = 2.36$, $p = .005$: Wilk's Lambda = .019: partial eta square .547.

Classroom temperature. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was temperature of classroom. Preliminary assumption testing was conducted to check for normality, linerarity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the five groups on the combined dependent variables, $F(24,36) = 1.14$, p =. 354: Wilk's Lambda = .140: partial eta square .389.

Building painting schedule. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was painting schedule. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the five groups on the combined dependent variables, F(6,10) = .0344, p = .898: Wilk's Lambda = .829: partial eta square 0.171.

Colour of walls. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was the colour of classroom walls. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the four groups on the combined dependent variables, F(18,28.77) = .89, p = .587: Wilk's Lambda = .284: partial eta square .343.

Condition of internal walls. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was internal wall condition. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the five groups on the combined dependent variables, F(18,28.77) = .89, p = .587: Wilk's Lambda = .284: partial eta square .343.

Condition of external walls. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was external wall condition. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the five groups on the combined dependent variables, $F(6,10) = 1.48$, $p = .276$: Wilk's Lambda = .529: partial eta square .471.

Condition of ceiling. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was ceiling condition. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the five groups on the combined dependent variables, $F(12,20) = .790$, $p = .656$: Wilk's Lambda = .460: partial eta square .321.

Classroom cleaning schedule. A one–way between–groups multivariate analysis of variance was performed to investigate age differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was classroom cleaning schedule. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the five groups on the combined dependent variables, F(12,20) = 2.43, p = .038: Wilk's Lambda = .165: partial eta square .594.

Condition of bathrooms. A one–way between–groups multivariate analysis of variance was performed to investigate condition of bathroom facility differences in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was condition of bathroom facilities. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the five groups on the combined dependent variables, F(12,20) = 2.43, p = .038: Wilk's Lambda = .165: partial eta square .594.

Condition of grounds. A one–way between–groups multivariate analysis of variance was performed to investigate condition of school grounds in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was condition of school grounds. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the three groups on the combined dependent variables, F(12,20) = .849, p = .605: Wilk's Lambda = .439.

Condition of furniture. A one–way between–groups multivariate analysis of variance was performed to investigate condition of furniture in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was condition of furniture. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There was no significant difference among the three groups on the combined dependent variables, $F(12,20) = .86$, $p = .595$: Wilk's Lambda = .435.

Presence of graffiti. A one–way between–groups multivariate analysis of variance was performed to investigate graffiti presence in high schools in Jamaica. Six dependent variables were used: English Language, Mathematics, Principles of Accounts, Principles of Business, Social Studies and Visual Arts. The independent variable was presence of graffiti. Preliminary assumption testing was conducted to check for normality, linearity, univariate and multivariate outliers, homogeneity of variance covariance matrices, and multicollinearity, with no serious violations noted. There were statistically significant differences among the four groups on the combined dependent variables, $F(18,28.77) = 2.03$, $p = .044$: Wilk's Lambda = .098: partial eta square .538.

Appendix V: Multivariate Analysis – Wilks' Lambda (83)

Table V1

Multivariate Analysis – Wilk's Lambda (83)

Variables	English
Building Age	.007*
Window Presence	.388
Window Condition	.005*
Quality of Light	.121
Temperature of Classroom	.354
Painting Schedule	.898
Condition Interior Wall	.234
Condition of Exterior Wall	.276
Condition of Ceiling	.656
Classroom Cleaning Schedule	.566
Bathroom Adequacy	.038
Bathroom Condition	.669
Bathroom Cleaning Schedule	.864
Presence of Graffiti	.044*
Condition of Classroom Furniture	.595
Condition of School Grounds	.605
Color of Classroom Walls	.587

Appendix W: Structured Conversation – Ministry of Education

Questions for Architect, Chief Building Officer

1. How many years have you been the Chief Architect for the Ministry of Education?
2. What process did you use to choose the designs for the precast molds?
3. Are you aware of any school design deficiencies in school buildings?
4. What are the types of building methods that are employed in school buildings?
5. Are there any standards to which schools in Jamaica are built? (Use the questions on the questionnaire as a guide to ascertain specification.)
6. How many school spaces are required by parish?
7. Precast structures seem to limit the natural light coming into classrooms, what consideration can be given to this?
8. What are the design considerations in locating new schools?
9. What determines the kind of construction methods?
10. What role does the architect play in the expansion and renovation of schools?
11. How much control does the architect have in regard to expansion and renovation of schools as opposed to principals and school boards?
12. Does the ministry have any say in how monies raised by the school are spent in regard to expansion, repairs or renovation?

Questions regarding building standard and specification for Building Officers

1. Is there a maintenance plan/annual operation plan for the schools?
2. Is there a strategic plan for the school facilities? (Ask to see a copy.)
3. What problems do you encounter performing your duties?

4. In your opinion, is the ministry being proactive or reactive in planning for changes? Changes may refer to the population, environmental changes, storm, hurricane. What are the proactive steps we are taking to deal with changes?)
5. (Ask to see organizational chart.) If there is an organizational chart, are all staff familiar with it?
6. How is communication between head office and branches done? What channels of communication exist (e.g. do they have regular staff retreats, field visits, documentation of meetings, texts, BlackBerry?)
7. Is there a policy and procedures manual? (If so, ask to see it.)
8. Does all staff have job descriptions?
9. Does Facilities Management staff have access to orientation and training?
10. Are you satisfied with salary and benefits?
11. Are salaries on par with other facility operators?