MASTER OF ARTS IN EDUCATION SAINT MARY'S UNIVERSITY

THE DEVELOPMENT OF COMPUTER EDUCATION IN
THE BERMUDA SCHOOL SYSTEM

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BY
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ABSTRACT

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This study examines the development of computer education in the Bermuda school system. Three phases are encompassed, the historical development, a questionnaire which surveys government and private schools, and conclusions with recommendations for the Bermuda system. A literature review of other similar studies was done, with particular attention paid to accepted standards, scope, development, studies, and recommendations made.

The literature review compares similarities and differences that Bermuda shares with other countries which have recently introduced computers as an integral part of the curriculum. Two appendices (I and II) are in the form of questionnaires, and accompanying each of them is a glossary of questionnaire terminology (Appendix III), and a letter of introduction to the participants (Appendix IV). The results of the questionnaires and a study of what was found after analysis will influence the recommendations made for the future of computer education in Bermuda.
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In Halifax, Mr. Peter Delefes, Principal of Grosvenor-Wentworth school, for suggesting the computer study done in the Halifax School System, Mr. Glane Gorveatt, my faculty advisor, and Dr. Bernard Davis, who guided me to a successful end in the writing of this thesis.
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INTRODUCTION

a) Purpose of the study

The purpose of this study is to investigate the present status of computer education in the Bermuda school system. Through questionnaires submitted by participants, recommendations will be made based on:

a) the results of the opinions expressed
b) the results of what was found after analysis

This study was undertaken for several reasons. First, no in-depth investigation was previously made with regard to the status of computer education in Bermuda. Second, it was important to establish whether or not the aims and goals of the Ministry of Education were being met. Third, it was hypothesized that some questionnaire opinions would be contrasted, with a significant variation expected between two groups.

With any new developments in education, studies, surveys, criticisms, and recommendations, are necessary. Having computer literate secondary students is a goal of the Ministry of Education. Since no major study on the introduction of computer education in Bermuda was ever undertaken, then one would be of benefit to the Ministry of Education and me.
b) HISTORY OF EDUCATION IN BERMUDA

INTRODUCTION

The following background information was obtained from "Reports of the Board of Education to the Legislature, 1873-1916", henceforth referred to as "Report(s)". Much of the content contained in these reports of the Board of Education to the Legislature from 1873 through the early 1900's concerned attendance statistics for the children attending the various schools, the names, the locations, and the number of schools in operation, and the cost of maintaining these small facilities.

The first year of operation for The Board of Education was 1873. Much of the content of their first report concerned information on the operation of the two schools located in St. Georges, information on students' attendance, and information on operating expenses and salaries paid to the teachers (Report, 1873).

All private schools in 1874 were aided by a Legislative grant, while the non-private schools belonged to trust bodies. The non-private schools were principally buildings provided about the year 1834 by charitable societies for the education of the emancipated negroes, and were still being utilized by their descendants in 1874 (Report, 1874).
In 1876 another school was opened at St. David's Island. Unfortunately, it seemed as a new school would open another would close. For instance, the attendance at the schools frequented by white children was often small, and the consequence of this low attendance was that the teachers found the remuneration inadequate (remuneration was dependent upon students' attendance), so they closed the schools and sought other means of livelihood (Report, 1876).

Topics from the 1883-1884 reports included:
1. the establishment of basic requirements for students passing from one grade level to another
2. the closing of a school in Paget Parish, which had been open since the first day of October, 1881.

Prior to 1883, there was no standard (required subjects) established for student promotion. From 1883 on, students required basic subjects (English and mathematics for instance) in order to be promoted to a higher level.

The school in Paget Parish had to be closed for two reasons, declining enrollments and the inability of the teacher to keep together a number of pupils to meet the requirements of the Board's rule. Another closing, the coloured school at the Crawl (conducted for about two years by a Canadian teacher), ceased operation after the teacher's departure for
By 1885 there were 23 schools in operation. Teachers received aid from an annual grant, which was voted by the Legislature and intended for the aiding and encouraging of schools in Bermuda. Unfortunately, due to poor attendance and dwindling funds, some schools did not stay in operation long. For instance, by the end of March 1886, the school for white children in St. Georges closed when the committee ceased to be able to guarantee the payment of the teacher's salary. (Reports, 1885-1886).

This pattern of schools opening and closing, of teachers unable to stay due to a lack of funds, and of working conditions which were less than adequate, continued on into the early 1900's. Eventually, the importance of education became more meaningful, and by 1916 significant changes had been made. For instance, there were now categories of schools, some with higher and others with lower academic standards. In general, a more adequate system of funding was established and a greater semblance of stability began to appear within the educational system (Reports, 1890-1916).
HISTORICAL - Records dating back to the seventeenth century indicated a desire for formal education. Bequests of land for the support of schools and teachers were made in various parts of the island by members of the Bermuda Company and others interested. The rents for most of these lands, however, were not applied to the purpose for which they were intended, and possession was eventually resumed by the heirs of the donors. It was not until 1816 when "school lands" were found in three of the nine parishes, that a law was passed vesting these properties in a body of trustees. The proceeds of the sale of two properties was transferred to the trustees to establish a college or classical school for white boys, this on the Devonshire Parish land (further reference later on, 1829).

With the exception of a few private schools maintained by resident clergymen, little provision was made during the eighteenth century for the education of children. Several unsuccessful attempts were made during the eighteenth and nineteenth century at starting formal education, such as the Bishop Berkeley Scheme, the proposed Marine Academy (In 1794, a law was passed to raise a sum of money by means of a lottery for the establishment of a Marine Academy. The money, however, was never raised.), and the Rev. W. C. Dowling scheme of 1852. One school which did succeed in the early nineteenth century was established by a religious
society (Society for the Promotion of Christian Knowledge), to encourage grants-in-aid schools for the poorer white children. After emancipation in 1834, grants were extended to a few schools for coloured children. The former, which was opened on the Devonshire land 1829, had a brief history and closed in 1834 due to its distance from the main population. The proceeds from its sale led to the purchase in 1893 of eight acres of land and school buildings, which is the present site of the Saltus Grammar School.

After the year 1816 small grants were made from time to time by the Colonial Legislature for aiding schools for poorer white children, and in 1837 a resolve was passed making grants available in aid of their salaries to each master of the four schools for emancipated negroes. By 1839, the grants were extended to include all elementary schools, the majority of students being coloured. In 1847 the Governor of Bermuda sent the first message to the Legislature on the subject of education. The message contained a number of important recommendations for the improvement of education, amongst which was the suggestion that a normal school be established for the purpose of spreading Christian education.

In 1856 a new Act was passed which provided for a Board of Education and an Inspector of Schools. When this act ex-
plied in 1860, no new schools Acts were passed until 1867 and there has been continuous legislation on the subject since.

Of particular importance was the Act of 1879, which provided for a Board of Education, an Inspector of Schools, local Boards in each parish, and annual grants, all of which formed the foundation for the present system.

Later enactments saw:

1. the title of Inspector of Schools change to that of Director of Education (1914)
2. Local Boards cease to exist with the passing of the Schools Act (1922)
3. attendance at school become compulsory (1930)
4. provision be made for the training of teachers (1931)
5. manual training/domestic science training centres be established (1932-1936)
6. pensions for retiring teachers be improved (1934)
7. the establishment of the right of children ages 7 to 13 to receive free education (1949)
THE SYSTEM OF EDUCATION - Under the provisions of The Education Act of 1954, the general administration of education was vested in the Board of Education, who were required to act as advisers to the Governor in matters relating to education. The Act stated that the Board should consist of not less than seven and not more than eleven persons who were appointed by the Governor. Members included a Chairman, a Deputy Chairman, and nine other members. The Director was the official advisor and chief executive officer, and members of the Department staff included an Inspector of Schools, two Supervisors, an Organizer of Physical Education, one Attendance Officer, and clerical staff.

There were two categories of schools, "vested" and "non-vested". Management in vested schools was by local committees or governing bodies, to whom the Board of Education made annual grants (under certain conditions). The non-vested schools were directly administered by the Board of Education and there was no committee between the school and the Board. There were fourteen vested and seventeen non-vested schools and with the exception of two private schools, none were denominational.

The Schools Act of 1949, which was now embodied in The Education Act of 1954, established the right of all children
of compulsory school age to receive free primary education. This provision led to a further division of the schools, ones that were free and others which charged fees. The free schools included four vested and fifteen non-vested, and the non-free included eight vested secondary schools (five of which also provided primary education), two non-vested secondary, and one vested primary school. With the exception of four schools, all were co-educational and English was the instructional language used throughout Bermuda.

By 1957, primary and secondary schools were well established, although there was some variation in primary school entrance age. The Schools Act (1949) required children at age seven to be in attendance, but many schools were accepting children at age five. This resulted in a student age disparity transferring from primary to secondary school, which was normally at age thirteen, though younger qualified students could transfer. Secondary school selection utilized aptitude testing, since all schools were not of the same standard. The schools normally provided a three year course with a fourth year for students who desired to take external examinations for university admission, (Reports of the Director of Education, 1950-1957).

At the end of 1963 there were twenty maintained primary
schools and one aided, which between them contained children of all ages from five to fifteen years. There were primary departments attached to four aided secondary schools; there were twenty-nine private primary schools (twenty-six of these for children under seven years of age), and there was a primary and secondary school established at the United States Air force Base. The division between primary and secondary school was accepted as the end of the sixth year of primary schooling, at approximately eleven years of age.

By the end of the 1963 school year there were 9595 pupils enrolled in the aided and maintained schools and 2076 in the private schools, for a total enrollment of 11,671 pupils, of whom 5649 were boys and 6022 were girls.

Efforts to persuade the majority of larger vested schools to voluntarily reorganize the chaotic system of education came to an end in January, 1963, when the Board acknowledged a ruling by the Governor that he intended to utilize the services of an educational advisor. This impartial observer would look into the educational scene and submit a report which would take into account the vital issue of integration for the races in the schools. It had become obvious that the issue of integration could not be separated from that of reorganization, however desirable it might have been to keep educational issues uppermost and emotional overtones apart.
Therefore, an agreed scheme of reorganization for three grammar schools, one co-educational and the other two single-sex, together with a technical school and a number of secondary schools, became inoperative when a key member withheld its support and later decided to become a private institution. All further action was postponed until the educational adviser's report had been received.

The curriculum of the secondary school had traditionally been influenced by the demands of the external examinations used as tests for admission to university. However validly these examinations controlled the curriculum of pupils entering higher education, it was less than satisfactory that they should so strongly affect the school life of the majority of children, who were not embarked on that route. A satisfactory substitute for examinations may not have been found, but that should not reflect poorly on the general examination adopted as a test for secondary school leavers. The opportunity was there to experiment and evolve the best educational tools to train responsible young Bermudians. These schools were not meant to be weak carbon copies of the grammar schools, nor should the pre-university oriented schools assume a superior attitude, as many did.

By the end of 1963, the efforts of two prominent educators Mr. H. T. Watlington and Mr. P. W. Peakins were lauded.
Their determined efforts to correct existing anomalies and to try and provide a better standard of education for every Bermudian child had not been in vain. They had brought into being a number of new institutions - the Technical Institution, the Hotel School, the new secondary schools, the school for handicapped children, and the special school for educationally sub-normal children. They had made repeated attempts to bring about a reorganization of secondary school education that would overcome the poor standards of pre-university courses. They had debated the issue of integration of the races in school and had forwarded a document expressing their views. They had taken the initiative in gaining what they considered fair recompense for teachers. Although not completely successful in all of their endeavours, unresolved issues were brought to light and many of them had been settled in later years, (Report of the Director of Education, 1963).

The 1979-1980 Annual Report disclosed the organizational structure of the Ministry of Education. Briefly, from the Minister of Education, the Board of Education was on one side of this flow chart, the Board of Governors on the other with the Bermuda College beneath. Below the Minister was the Permanent Secretary from which the Department of Education, the Bermuda Archives, the Bermuda Library and the many Supported Organizations stemmed.
The school system during the 1979/80 academic year comprised the following:

11 government and 30 private nursery schools
17 maintained, 1 aided and 4 private primary schools
5 maintained, 4 aided and 4 private secondary schools

These schools were open to all students without regard for race, creed or national origin and all Government schools were tuition free.

Six years previously, the Bermuda Secondary School Certificate (BSSC) had been introduced so that all exams in government schools would be standardized, with the goal that this standard would be acceptable by institutions of higher learning. Students were required to do English and mathematics courses in their 4th and 5th years, obtain a grade point average of 1.5 over the entire course, achieve a minimum of 65 course units, and pass the minimum competency tests in mathematics, reading and English language. At the close of the 1978/79 school year, two hundred and thirty students had become the first to receive their BSSC.

With the introduction of the BSSC examinations, curriculum development became very important. Committees for each of the disciplines were established and new standardized courses were developed and tested, such as general mathematics year one. By the end of 1979 only mathematics,
English and physical education were mandatory for each year of the program. The production of curriculum materials in all subject areas was a major goal of the 1980's and in order for students to receive BSSC credits, it was hoped that all participating schools would enter students for subjects in which committees had developed tests. So, exam standardization was now imperative, (Ministry of Education Annual Report, 1979-1980).
Two studies were used to compare the development of computer education in Bermuda with. First, the Halifax City School Board's report titled "COMPUTERS AND TECHNOLOGY: A REPORT ON THE INSTRUCTIONAL USE OF COMPUTERS IN THE HALIFAX CITY SCHOOLS". Second, a report made public by the Australian Commonwealth Schools Commission, Canberra, titled, "TEACHING, LEARNING AND COMPUTERS: 1984 INFORMATION KIT".

Halifax was selected for comparison with Bermuda because of my familiarity with its system of education. Having previously taught in Halifax City (and neighbouring Dartmouth City), I saw from the onset the introduction of computers into the schools. Also, the Halifax school system differed in structure from Bermuda's (elementary school, junior and senior high school, and age of entrance and departure), and student exposure to computers and how computers were utilized within the curriculum, were dissimilar.

Australia was selected for comparison with Bermuda for these reasons: first, because of its physical distance from Bermuda, as a school system located on the other side of the world, it seemed interesting; second, the absence of direct influence from North America, as is experienced by Bermuda;
third, Australia possessed a cultural heritage similar to Bermuda; and fourth, the systems of education in Australia and Bermuda were somewhat similar. Therefore, a study of the development of computer education in that country seemed appropriate.

Both studies introduced the historical development of computers into their school systems and defined goals, aims, philosophy of computer introduction into the classroom, what was perceived as the future of computer education, whether they attained their immediate goals, and the recommendations they viewed as relevant. The Halifax studies were less detailed and are discussed first.

The report of 1981 titled "PROPOSAL TO EXTEND COMPUTER EDUCATION IN HALIFAX CITY SCHOOLS", was the first produced by the curriculum department. The rationale behind computer introduction was: since advancements in technology were inevitable and since computers were a major component of this advancement, then it was necessary to have them properly introduced with appropriate training in how they can best be used and incorporated.

Long-range program plans included a recommendation that staff study the ways computers were being used in the classroom. The initial study was the beginning of a larger one
which determined whether instructional policy in the use of computers should extend to include all schools.

The primary goal was to devise a suitable program, determine the costs for additional hardware and software, and to establish a realistic time-frame for development. To review what was already in place, the committee had to start at 1970, when students in high school had the opportunity to take introductory programming at local universities.

In 1973 a course in data processing was introduced at one high school, followed by a pilot program established at two more high schools, which connected them by terminal to a university.

In 1976 the pilot program was dropped and Halifax City began its own, which introduced BASIC programming in grade 10 mathematics. This resulted in the first large volume buying of hardware in the form of micro-computers. By 1978 there were approximately 200 students receiving instruction in programming, which increased to 1200 by 1979, and up to 2000 by 1981.

In 1980 pilot courses in Computer Science were presented to the Department of Education for approval, and began in 1981. There were approximately 268 high school students enrolled
There were similar developments in the junior high and elementary schools, each with their own particular aims and goals. As a consequence, more and more teachers became qualified to give instruction in the use of computers. Subject areas other than mathematics became involved, so computers were being used in economics, chemistry, physics, and business education. As of October of 1981, "Study has revealed that the instructional units and full-time elective courses that have been introduced have met with success both in the junior and senior high schools, and a large number of students have benefitted as a result" (Computers and Technology, 1981).

System priorities were:

1. to establish, in successive stages, a universal program of basic instruction developed around the mini-computer* and calculator.
2. to offer advanced courses of instruction.
3. to determine guidelines for the best use of computers and calculators as aids of teaching and learning.
4. to make periodic revisions in programs if, in the light of experience and after study and assessment, such revisions appear necessary.
The following objectives were then set:

1. the introduction in junior high school of a basic program in computer literacy and elementary programming, all within the existing mathematics program.

2. the extension of the program presently offered in the high schools to include all grade X students.

3. the development of an advanced elective course in computer science and data processing in grade XI and grade XII.

The instructional objectives were:

1. To remove the "mystique" associated with the whole field of micro-technology and have it accepted as a matter of daily routine.

2. To teach students "literacy" so as to understand the impact of computers and microtechnology in the world around them.

3. to teach students to be users and programmers so they might be able to apply their knowledge in other curricular areas.

4. to give students the opportunity to explore an area which might lead to future job opportunities.
to expose students to the formal deductive (logic) process which is required to program a computer.

Halifax City Schools had:

1. 1970 - first computer instruction at high school using university facilities
2. 1972 - first high school elective course approved (Data Processing)
3. 1975 - two provincial APL pilots (terminals connected to Dalhousie University)
4. 1977 - permanent terminal installations in all four high schools ($17,000)
5. 1978 - first purchase of four microcomputers and printers (Commodore PET 2000 series - 8K memory) ($5,000)
6. 1981 - (October) first major report to Halifax Board of School Commissioners to expand computer education to all Grade 8 and Grade 10 classes ...
7. 1982 - System wide computer curriculum committee
8. 1983 - Gradual expansion of purchases of microcomputers in all areas of the school system.

As stated in the curriculum department presentation, "there is a genuine and immediate need to educate young people about computers in as much depth as possible and to help prepare them to apply the device as a learning-teaching
tool" (Computers and Technology, 1981).

The second Halifax report was a memorandum to the director of education from the coordinator of senior high school education. Titled, "THE STATE OF COMPUTER USAGE IN THE HALIFAX CITY SCHOOL SYSTEM", it included reports submitted by members of the elementary, junior high, senior high and special education departments. A key issue dealt with financial recommendations, since it was up to individual schools to provide much of the hardware and software.

Reports from the senior high school revealed a marked decline in computer literacy courses and a shift to the junior high school for this introduction. Other topics covered were specialized courses, instructional/learning aids, and applications. All administrative functions of time-tableing, student reports and attendance were fully computerized according to the memorandum.

The number of students taking courses about computers was reduced, but it was expected that there would be more students, coming in from junior high school, using computers for writing, problem solving, drill and practice, and fewer students using them for programming. Mitchell (1987) suggested that "usage will not lessen, but it will change".
All computer courses used in Halifax City schools do conform to the guidelines established in the Province of Nova Scotia Curriculum Guide (Computer Related Studies, CRS 331 and CRS 441).

AUSTRALIAN COMMONWEALTH SCHOOLS

The Australian Commonwealth Schools report was an in-depth, detailed study which included recommendations and guidelines for the development of a national computer education program for all Australian schools.

Through the efforts of many enthusiastic individuals (teachers and parents) in the early 1980's, there were a limited number of computers introduced to a few schools. Realizing the universal impact of computers, state education authorities took steps to promote and support the systematic development of computers in government schools.

In the 1984 recommendations report, the Commonwealth Schools Commission indicated the need for a satisfactory program of computer education, which would be of fundamental importance to Australia. Also, the Commonwealth was urged to commit itself to the development of a national computer education program for all Australian schools, commencing in 1984. Such a program would be directed at the development of
computing skills in teachers and students, awareness of the possibilities and importance of high technology, and the use of such technology for teaching and learning in schools.

On July 28, 1983, the Minister of Education and Youth Affairs announced the guidelines for the 1984 Schools Commission program. The guidelines of the Computer Education Program had the following objectives:

1. the need for students to have an understanding of the uses of new technologies...
2. plan for the use of computers in teaching and across the curriculum...
3. professional development of teachers

Initially, only secondary schools were involved, with future extension to include the primary schools. Next, the National Advisory Committee on Computers in Schools was given the following terms of reference:

1. the use of computers in schools, as they relate to the educational needs of boys and girls enrolled in primary, secondary and special schools
2. the rationale for a national program, including desirable short and long term educational, social and economic outcomes
3. an implementation plan, and associated guidelines, for the introduction of a National Schools Computing Program into primary, secondary, and special schools
The committee then met several times and established technical working parties in Curriculum and Professional Development, Software/Courseware, Hardware, Evaluation and Support services. Many external organizations were consulted and became intimately involved. All of this support was important in getting the program started and working well.

Most secondary schools in Australia now have computer programs as part of their curriculum. Most education departments have a person or a group responsible for computing in the schools. As for the funding for hardware and software, there is a sharing between government and the schools involved. Since Australia is somewhat isolated with respect to the United States and Europe, there was a serious lack of curriculum material and quality software available. Fortunately, there was such a high demand for both the material and the software, that there now seems to be more available from the United States and Europe.

Representatives of the many state education boards spoke out in favour of the incorporation of this new technology. For example, late in 1982 the New South Wales Minister for Education issued a general guideline statement on computers and computing in education. He suggested that the primary goal for introducing computers into schools should be to provide computer awareness for all. Then in 1983 the
Minister released the Department's policy statement on the use of computers in schools, which included some minimum goals students were to achieve before leaving. Next, optional courses were offered in computer studies for students and they were to be included in the School Certificate.

Australia is a large country with a relatively small population. It was therefore necessary to devise a national program which would benefit all. The rationale behind a national program was:

1. a national program could help ensure that schools and systems had adequate resources to provide access to computing for all students.
2. a national program would help remove regional disparities by encouraging schools to design and implement related curricula.
3. a national program could help remove the unnecessary duplication of effort.
4. a national program could be a means of encouraging the growth and development of the Australian computer industry, and could lead to sales of both hardware and software in the domestic market.

The general aim of the national program was to assist teachers, school administrators, and resource managers, and to provide students with the resources to learn about and to
use computers and computing. From the committee's perspective, these were some of the desired outcomes of schools' computing programs:

STUDENTS should learn to:

1. use computers for inquiry, information processing, problem solving and recreation
2. recognize the sort of problems which are not amenable to computer solutions
3. undertake a formal study of information processing or appropriate aspects of it

TEACHERS should:

1. study and experience the use of computers in schools through pre-service and in-service courses
2. experiment with imaginative and effective use of computers in schools
3. use computers for their own word processing, database management and graphics manipulation

There were several considerations made under the heading, "OPERATIONAL PRINCIPLES UNDERLYING THE PROGRAM". One suggestion that computers could be used in schools to support the equality of outcomes in education, might have various interpretations. Computers could help with remedial work, so a particular topic could be reinforced using drill
and practice. Students with handicaps or with difficulty expressing themselves orally might also be better served using a computer.

Another concern, that secondary schools should be the initiators of new programs, was not exceptional. Typically, secondary school exposure to new technology preceded primary school introduction.

A third point considered was that of community involvement in the decision-making process. Parents should not be limited to receiving information about computers, but should also be involved with the decisions concerning the acquisition and allocation of funds.

These were a few of the principles which the committee felt should be followed with the introduction and administration of the program. The report also described proposals for curriculum and professional development and support services.

Under the heading, "CURRICULUM DEVELOPMENT", provisions were made throughout primary and secondary schools to incorporate computing as a teaching/learning tool and to include topics about computers at the appropriate levels. For this goal to take place and to stay in line with the latest technology,
the availability of interesting and motivating materials and a constant review of all curricula was necessary. The committee felt that new developments should take place within the existing curriculum structure and a national mechanism for disseminating information about curriculum issues should be established.

"Computer awareness" and "computer literacy" were terms used to describe courses introduced at the lower secondary and upper primary levels. Computer awareness referred to the nature and use of computers and the social implications of their use, whereas computer literacy meant the functional aspect of computers, with respect to the skill of operation and familiarity with hardware and software. The following were used in government schools:

1. drill and practice
2. tutorial
3. problem solving
4. word processing
5. spreadsheets

These topics were common to computer studies programs found in most school systems and are practical and relevant for most students.

Some of the more important recommendations made were:

1. the development of computer awareness and computer
literacy for all students in the years of compulsory schooling

2. the promotion of the integration of computing into the school curriculum, (primary and secondary schools)

3. the provision of optional computer studies courses at the secondary level

Proposals for software/courseware and hardware were the next considerations the committee defined. Some of the suggested guidelines for software/courseware were:

1. to enable students to use the computer as a tool for inquiry, analysis, and problem solving

2. to assist students to understand the variety of applications of computing

3. to enable students to acquire skills which have vocational implications

The committee then defined various categories of software and courseware, their development and distribution, and the programming languages used at various levels.

Their next major consideration was hardware. There was a diversity of incompatible equipment and software which did not allow for a uniform curriculum throughout the system. To meet the long-term requirements of school computing it
was essential to begin a national research and development project to ensure that appropriate computer systems were available. Meanwhile, interim support for microcomputers was twofold. The first called for activities which included provision of software, professional development and maintenance of existing equipment. The second suggested financial assistance for the acquisition of computers for the schools. The latter was to be implemented if applicant schools developed appropriate curriculum, and if the computers purchased were the latest available on the market. There was also a need to establish a national purchase price for hardware as part of the overall standardization process.

The organization of the program was to include the following:

1. The administration of the program on the advice of representative committees.
2. The appointment of a National Co-ordinating Committee on Computers in Schools.
3. The development of procedures for effective program evaluation and for research and development activities, by the National Co-ordinating Committee.
4. The giving of precedence to computers in schools by the Curriculum Development Centre.

Most of the recommendations made were implemented. The major difficulty was the nationalization and standardization
of computer education in such a large country; an arduous but realistic goal, which is slowly being realized.
HISTORY OF COMPUTER EDUCATION IN BERMUDA

Computer education had its beginnings at the Bermuda College in 1976. Established in 1974, the college provided educational and training opportunities at the post-secondary level for Bermudians (Bermuda College. Calendar of Full-Time Studies, 1978-79). Information on computer development at the college was made available through Mr. Bertram Gulshard, Head of General Studies, Mr. A. Peter Woodhouse, past Director of the College’s Computer Centre, and Mr. Thomas Coelho, present Director of the centre.

In May of 1976, Bermuda Business Machines donated an N.C.R. (National Cash Register) Century 100 computer to the Bermuda College. This enabled the college to offer a wide variety of courses in electronic data processing and thereby meet the local needs for trained personnel in this expanding field (The Ministry of Education. Annual Report, 1976). Woodhouse (1987) indicated the N.C.R. Century 100 had integrated circuits, paper-tape input, a line printer, 16 K of memory, and 2 - 5 megabyte disk drives. The computer was able to process programs in three languages, NEAT/3, COBOL/1 and FORTRAN/B, but at that time the N.C.R. Century 100 was not able to utilize BASIC as a usable language. This computer soon became dated, even after the addition of a punched-card reader, and it was just a matter of time before a major
upgrading of the facility became necessary.

In 1977 an instructional language CESIL was used throughout the college. Originally developed by ICL (International Computer Limited) of the United Kingdom, CESIL was used as a tutorial for in-house staff. Also, the Business Education Department began using the system for simple accounting and some data processing. By 1978 this original system was unable to handle all of the college's requirements, so a second computer, a Burroughs 1700, was purchased. This computer system was in use until 1986 and held all of the students' records. In 1980 a Burroughs 1855 with 1 megabyte of memory, and utilizing disks having 65 megabytes of memory, was purchased. This machine had 12 terminals, 6 of which were used by the students and the remaining 6 by the college staff. Programmers were hired and students had access to the computer centre.

Coelho (1989) described the present system, with the addition of a VAX 780 which has 12 megabytes of memory and a microVAX 3600 with 32 megabytes of memory, they form a cluster containing 2/456 megabyte drives, 1/622 megabyte drive, and approximately 100 terminals for student and administration usage, all connected by a single ethernet or LAN (Local Area Network). There is a micro-computer room with 14 IBM PC's, a Burroughs 1988 with 50 terminals, for
administrative use, and a System 38 IBM mini-computer, so there are many opportunities for students to use the College's system, for programming, Computer Assisted Instruction, and computer applications, such as word processing or using spreadsheets.

Computer introduction in regular government schools was not quite as early. Information on the development of computer education was made available through Dr. Joseph Christopher, Senior Education Officer, Special Services, Mrs. Marva Phillips, Education Officer and Coordinator of Computer Education, and Mr. Jack Rhind and Mr. Anthony Outerbridge, Assistant Computer Coordinators. Written information was made available through the Ministry of Education newsletters which were published quarterly by Mr. Ronald V. Johnson, Education Officer, and Head of Library Services.

"Sandys Secondary School made its first step towards computer technology at the end of 1979 when a TRS 80 microcomputer was purchased. Under the guidance of Principal Dr. Joseph Christopher and Alan Davies - our first head of computing in a secondary school - the TRS 80 was put through its paces. Beginning with teacher-made programs for basic numeracy and vocabulary, it was but a short step to using the computer to store and process pupils' academic records and processing examination results" (Ministry of Education.
Dr. Joseph Christopher, Senior Education Officer, was instrumental in introducing computers to government schools. The TRS 80 Radio Shack computer at Sandys Secondary was the first in the system, and shortly afterwards other schools followed. The machine had 48 K of RAM (Random Access Memory), and the disk drives were single sided/single density and used diskettes with about 90 K capacity.

Rhind (1989) explained that in 1981 some students of the Whitney Institute were introduced to computers. A TRS 80 Model I, similar to the computer at Sandys Secondary, was used for programming in BASIC, and problem solving in physics and general science. Whitney Institute had one of the first secondary school computer clubs, with meetings held after school hours for some "hands-on" computing.

After Sandys Secondary had received its first computer, the Premier of Bermuda had a special committee formed, headed by Mr. Deforest Wheeler "Shorty" Trimmingham, to look into the feasibility of introducing computers into the school system. In 1983 this introduction took place, and teachers underwent training with a local company called P.I.S. (Professional Information Services). Computer literacy of teachers was their immediate goal, and they held one-day workshops with
"hands-on" and as much immersion as possible. Various brands of computers were chosen through a committee and a pilot project was established which incorporated the participation of all the secondary schools and five primary schools. In 1982-83 the Bermuda Government gave one computer to each secondary school. The brand of computer selected was optional, and the variety included Apple II E, IBM, TRS 80 Model III, and Atari 800. Year III students were targeted (one exception, a year II group in one school) and computer literacy was the major goal. Students were to become familiar with the hardware, know some programming in BASIC and LOGO, and use software such as Visi-calc. Two teachers from each school became part of a steering committee which reported monthly on the progress of the program. By 1984 formal courses were introduced into the regular school curriculum and credited courses in computer studies soon followed.

Outerbridge (1989) explained that computers were introduced to the primary schools in 1982. Several of the schools were involved in a pilot project using Apple II E computers, with emphasis on computer literacy, software "learning" programs, and the formation of computer clubs. Most schools had a computer room and years 1 to 3 students usually attended once per week, while the older primary students worked with two scheduled periods.
From 1979 to 1983 computers in schools were a new form of technology and as yet untested as an academic subject. The BSSC (Bermuda Secondary School Certificate) exams were established in other subjects, but there were no standardized computer exams. A 1983 newsletter said, "In recent years computers have been quietly gaining ground in our school system. However, not until this school year has the computer received full recognition as a subject with status on the BSSC. This has now been remedied with the establishment of computer studies as a recognized subject on the secondary school curriculum. Chairman of the new subject committee is Mr. Jack Rhind of Whitney Institute" (Ministry of Education. Newsletter. Spring Term, 1983).

Christopher (1985), "Computer Education - The First Year", summarized the introduction of computers in government schools. Some highlights were:

1. A computer education project was launched in September of 1983.
2. Two committees were appointed, one by the Premier and the other by the Minister of Education.
3. Professional Information Services was asked to conduct workshops for teachers.
4. The long term aims were to increase pupils' knowledge of computers and computer technology, to encourage the use of computers as an instructional
tool and for administrative purposes.

5. Workshops were held for all teachers during the first and second term of the 1983/84 academic year.

6. A series of evening courses was organized with instruction in BASIC programming, introduction to LOGO, and using computers in the classroom.

7. A BSSC curriculum committee for computer studies was appointed.

8. A primary school syllabus was established.

9. Primary and secondary steering teachers committees were established, to report on the progress of the use of computers in schools.

10. The number of computers per school was increased from one to five, through government funding.

According to the newsletter, "there are plans to increase the provision of hardware, install a Computer Assisted Instruction programme on an experimental basis, install an interschool communication system and investigate and provide administrative software for schools" (Ministry of Education. Newsletter. Easter Term, 1985).

Philips (1984) reported from the department's Computer Centre on the pilot project on computers in education for the year 1983/84 and their importance in schools. She suggested that schools had no choice but to adapt to this
Informative Age and realize the full implications of this adaptation to our educational philosophy, goals and even teaching methods. This was an indication of the importance given to computers and the commitment the Department would give this new technology.

Essentially, computers were introduced into the classroom in September of 1983. During the school year of 1983/84, six primary, nine secondary and two special schools were involved in the first phase of the implementation.

The main objectives were:

1. To hold literacy workshops for all teachers for hands-on experience
2. To target a group of students with literacy skills
3. To evaluate software
4. To evaluate hardware

Some of the accomplishments were:

1. The development of primary and secondary school curricula
2. Night classes for teachers
3. The development of the Steering Teachers’ Committee
4. A summer computer camp for primary and secondary students
A statistical report indicated that there were 15 IBM-PC's, 10 Radio Shack TRS-80's, and 112 Apple IIe’s in use. Also, there were 210 students registered for summer camp and 80 teachers registered for night classes.

Computer development, usage, and the availability of courses in all government schools progressed well from 1980 to 1989. Most goals and aims concerning literacy have been accomplished, and students have become as familiar with computer technology as they have with televisions and VCR’s, which most have at home.

The introduction of computers into the educational system of Bermuda differed little from what occurred in both Halifax City and Australia.

Some of the elements found in the three systems (not common to all of them) were:

a) keen and adventurous teachers who saw a need for this advancement in technology as being part of the classroom setting

b) a high interest on the part of some senior educators who, through reports and visits to neighbouring school systems, saw the need for this advancement in technology

c) a high interest on the part of students who were
involved in the introduction of computers to the classroom

d) businesses which contributed by hosting workshops, donating hardware and software, and being the overseers of this computer introduction

e) the combined efforts of administrators, teachers, parents and businesses to ensure that computers in education were successful endeavour.

Bermuda has not suffered from a parochial growth as might be expected from a small isolated island. Its proximity to the United States and the strong influence of "Americanism" have undoubtedly helped. The separation of computer studies from mathematics, the standardization of hardware and software, and the open channels of communication from the Department of Education to the schools, were positive features which contributed to a progressive system.
METHODOLOGY

a) THE QUESTIONNAIRES

An essential aspect of this study was to determine if the aims and the goals of the Ministry of Education were being met. It was also important to determine whether these were the same aims and goals held by school administrators, teachers, and parents of students involved with computer studies.

The two surveys involved questionnaires, one which was distributed to Parliamentarians, members of the Ministry of Education, teachers of government schools, and the parents of students who attended government schools. The second questionnaire was directed at the administration and staff of private schools, and the parents of students who attend these private schools. I anticipated that responses from Parliamentarians and members of the Ministry of Education would differ significantly from the other respondents.

An explanation of questionnaire terminology for the government sector questionnaire (APPENDIX III) covered both, since the second questionnaire is an abbreviated version of the first.
Question one placed the respondents in a category, a necessary starting point, since it was anticipated that responses would differ notably according to their level of influence. So, Parliamentarians and members of the Ministry of Education were expected to respond differently.

Question two asked if a computer was available for use at home. Computer familiarity could have influenced answers on some of the questions, possibly causing more favourable responses. The hypothesis, "that if a computer was available for use at home, it could influence the respondents to answer more positively", was tested and noted (section III, p. 59).

Questions three and four were concerned with the effects on children of early exposure to computers. In speaking with parents during parents' nights and in informal settings, many of them expressed views that exposure to computers should be at a later stage than what is presently in effect in Bermuda (ages four to five years). This exposure, they suggested, should be as late as secondary school (approximately twelve years of age). These opinions influenced my posing questions three and four to see if this was the general consensus of the respondents. The hypothesis, "that parents' opinions differed significantly", was tested and noted (section III, p. 60).
Questions five, six, and seven referred to Computer Assisted Instruction and the use of educational software to supplement formal courses in school. CAI and educational software are used in many regular school systems and technical schools. Some students learn well using CAI, therefore, "will the computer replace the teacher?", was appropriate to consider. The questions emanated from discussions in a computer studies graduate course, where these topics were discussed and some schools were turning to computer software to enhance learning.

Many computer teachers have no control over the number of students in a computer class. Dissatisfaction over the timetable, class size, and having two to three students seated at one computer, were some of the complaints expressed by teachers in staffrooms and meetings. Questions eight and twenty-eight referred to these problems.

Questions nine and fifteen arose while teaching in Canada. Most schools received a limited number of computers and many were forced to purchase much of their own equipment. It has taken several years for Government to respond to the growing demand of computer education, and to provide hardware and software to adequately meet the needs of the number of students involved.
Some of the goals the system would ideally like incorporated are the standardization of hardware and software in primary and secondary school, computer literacy of secondary students, a central computer room in all schools, the availability of computers for teachers of various subjects, and the use of computers as an educational tool, not a form of recreation. The process of standardization is on-going and becoming well established. Computer literacy is a required course for all secondary students and most schools do have a central computer room, so questions ten, eleven, twelve, thirteen, fourteen, sixteen, seventeen, and eighteen are all concerned with this trend.

Question twenty-seven was meaningful to those teachers who have their computer classrooms used in the evenings by adult education, and find that the responsibility for all maintenance, repair, and overall upkeep lies with the regular day teacher. Should some of this responsibility be shared and should computers be replaced for day classes, if difficulties occur in the evening, and a computer is not operational? These issues needed airing.

Question twenty-six arose as a result of phone calls and conversation concerning the BSSC exams in Computer Studies. Teachers wanted to know what topics to emphasize, specific ideas and examples concerning a first time practical exam,
and a concern that members of the curriculum group have an advantage, since they have first hand information about the exams.

Many teachers in Canada work under a system whereby they are financially reimbursed (at least partially reimbursed) for successfully completing college/university courses in education. This is not a practice in Bermuda, and question twenty-one was meant to gauge if respondents were in favor of this.

The remainder of the questions nineteen, twenty, twenty-three, twenty-four, and twenty-five were all devised and based on personal observations as a computer teacher in the system and with feedback from fellow computer teachers. De-emphasizing programming and concentrating on applications seemed the proper direction to head. Students, in general, did not achieve as well nor had as much interest in the more academic and theoretical Computer Science course, whereas this was not the case with application courses.
b) **THE DISTRIBUTION OF THE QUESTIONNAIRES**

The questionnaires were submitted to Dr. Joseph Christopher, Senior Education Officer, who acted as my overseer in Bermuda with respect to questions asked and wording. In turn, Dr. Marlon Robinson, Permanent Secretary of Education, reviewed and edited the questionnaire until it was in acceptable form to be distributed throughout government schools. Prior to their distribution, a circular was sent from Mr. Dean MCL Furbert, Chief Education Officer, to the principals of all government primary and Secondary schools. Titled, "Survey of Computer Education", the letter introduced me as a teacher within the system who is pursuing a Master of Arts degree in Education, with specific emphasis on computer education. It was also indicated that I would be conducting a survey on the implementation of computer education and that the survey would be submitted to persons at all administrative levels within education as well as to parliamentarians and the parents of students.

The questionnaire was comprised of twenty-eight questions for government schools and five hundred in number were printed, comprised of three sheets each. The groups targeted were Members of Parliament, the Ministry of Education, the school administrators of the selected schools, primary and secondary teachers of these schools, and parents of stu-
dents from the selected schools. All questionnaires were placed in a pre-addressed, pre-stamped envelope, along with a letter of personal introduction, the purpose of the study, the impersonal nature of the questionnaire, and a sheet to help explain the terminology used in the questionnaire.

Questionnaire distribution to Members of Parliament was administered by the clerk to the House of Assembly. Personal contact was made with this gentleman, the required number was collected by him and then distributed to the Members of the House of Assembly.

Questionnaire distribution to members of the Department of Education was personally ensured by depositing the questionnaires in mail slots at the Department office. Contact was made with a member of the Department's Computer Centre, who in turn distributed the questionnaires there.

Primary schools, which are more numerous than secondary schools, were targeted based on their proximity to my school and to my route of travel to and from school. Teachers of several primary schools helped distribute the questionnaires to teachers of their schools. Questionnaires were placed in the mail slots of principals, their deputies, and all staff.

There are eight government secondary schools in Bermuda, and
all secondary schools but one were targeted. Distribution of questionnaires to school administration and staff members was by placement of the questionnaires in staff mail slots of the various schools. Staff members of four of the secondary schools helped with this and also with ensuring that questionnaires were sent home to parents. Students in homeroom classes or in computer classes were targeted by their teachers to take the questionnaires and have their parents respond.

Unfortunately, it was not until the questionnaires were distributed that an error was discovered with regard to question twenty-four. Whereas most secondary schools conform to two years of computer courses for their students, it is not a requirement. The only requirement is that students take one year of computer literacy, and all other courses are optional. Question (twenty-three) was also in error. ALL schools do not require that fifth year computer science be mandatory if fourth year computer studies was selected as an option. These two errors should not have any effect on the overall results.

Two private schools were targeted and permission to distribute the questionnaires was established after making contact with the respective principals. Their courtesy and willingness to permit the distribution was greatly appreciated, for
It contributed to a more complete picture of the status of computer education in Bermuda. Questionnaires were placed in staff and school administration mail slots and distribution to parents was done by the computer teacher with students of their home room or computer classes.

The computer education study was significant in that it was a "first for Bermuda. With any first time study, much is learnt and errors are made, which will only lend positively to any further study. There were a number of factors which are worthy of notation, for example:

1. There were errors in the questionnaires, as explained on page forty-nine.

2. The terminology was not always fully explained as it was sometimes abbreviated and worded with as little jargon as possible (Appendix III, p. 74).

3. The improper timing of the distribution of the questionnaires. The amount of time required for editing and approval by the Ministry of Education, together with the final distribution of the questionnaires in the third term of the school year, further contributed to the low response rate. Many questionnaires arrived in my mailbox as late as three months after distribution, which in turn made it difficult to compile final numbers for each of the groups.
The return rate for respondents of the government sector was lower than anticipated (50% return rate anticipated), with an overall average rate of 34.60%. The return rate for respondents of the private sector was considerably higher, with an overall average rate of 54.73%.

In defense of the lower rate of responses for the government sector, it should be noted that there were at least two other questionnaires distributed to government schools at about the same time, both concerning studies which were being conducted. This, combined with the busy schedules which participants had, assuredly contributed to the lower rate of return.

As indicated previously, ideally, the questionnaires should have been distributed at the beginning of the school year, during the latter part of the month of September or the first half of the month of October. At this time in the school year work loads are not as demanding and possibly many more answered questionnaires would have been received by a Christmas deadline.

Concerning the low rate of return for parents within the government sector (28.57%), it is possible that many of the questionnaires did not make it to their respective homes, since it was up to students to ensure their distribution.
Although the overall return rate of responses for the government sector was low, I feel that the validity of the conclusions drawn from this study will be acceptable. Also, it would appear from the variety of responses (responses were not consistent in any one direction), that the respondents did not represent only those who were "interested" members of a particular group.

When a chi-square analysis was done on questions answered by members of the government and the private sector, only two appeared to differ significantly. Therefore, it can be assumed that if the return rate for respondents of the government sector were extrapolated higher (from 34% to 54%), the responses would probably not differ significantly.
The questionnaire distribution breakdown:

### A. QUESTIONNAIRES - SET I

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<tr>
<th></th>
<th>Sent</th>
<th>Returned</th>
<th>Return Rate</th>
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</thead>
<tbody>
<tr>
<td>Parliamentarians</td>
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<td>11</td>
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<tr>
<td>Ministry of Education</td>
<td>35</td>
<td>16</td>
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<tr>
<td>School Administration</td>
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<tr>
<td>Secondary Teachers</td>
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<td>76</td>
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<td>Primary Teachers</td>
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<tr>
<td>Parents</td>
<td>112</td>
<td>32</td>
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<tr>
<td><strong>Total Distributed</strong></td>
<td>500</td>
<td>173</td>
<td>34.60%</td>
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### B. QUESTIONNAIRES - SET II

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<td><strong>Total Distributed</strong></td>
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<td>54.73%</td>
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### C. OVERALL RETURN RATE

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<td>Total Distributed - A.</td>
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<tr>
<td>Total Distributed - B.</td>
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<tr>
<td>Overall Return Rate (A+B)</td>
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### GOVERNMENT AND PRIVATE SCHOOLS

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Significant Questions:

**Question #12** - Standard type of computer in secondary school
- GOV: 68% Yes, 32% No
- PRIV: 51% Yes, 49% No

**Question #20** - Computer studies as important as core subjects
- GOV: 66% Yes, 34% No
- PRIV: 23% Yes, 77% No

A chi-square analysis of Government versus Private School responses indicated that the following results differed significantly:

a) Question #12 - Standard type of computer in secondary school

   - GOV: 68% Yes, 32% No
   - PRIV: 51% Yes, 49% No

b) Question #20 - Computer studies as important as core subjects

   - GOV: 66% Yes, 34% No
   - PRIV: 23% Yes, 77% No
### GOVERNMENT SECTOR - COMPARISON OF THE RESPONSES

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**Significant Questions:**

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A chi-square analysis of responses from Members of Parliament and the Ministry of Education (PM) versus school Administrators, Secondary and Primary Teachers, and Parents (ASPP), indicated that the following were significantly different:

Question #2 - Use of a computer at home
PM - 63% Yes  37% No
ASPP - 37% Yes  63% No

Question #13 - A central computer room in schools
PM - 74% Yes  26% No
ASPP - 94% Yes  6% No

Question #22 - Computer curriculum based on another country
PM - 59% Yes  26% Partial  15% No
ASPP - 10% Yes  72% Partial  18% No

Question #26 - Teacher access to the BSSC exams
PM - 58% Yes  42% No
ASPP - 89% Yes  11% No

Question #27 - Funds from night classes be used for maintenance
PM - 17% Yes  83% No
ASPP - 50% Yes  50% No
Hypothesis: Computer use at home influenced respondents

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Significant Questions:

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<td>ASPP - 90% Yes 10% No</td>
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A chi-square analysis of responses from PM's versus the responses from ASPP's indicated that the following were significant:

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Hypothesis: The opinions of parents are different.

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<th>Chi-Square</th>
<th>Degree of Freedom</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question #3</td>
<td>5.7065</td>
<td>1</td>
<td>Yes &lt;.05</td>
</tr>
<tr>
<td>Question #4</td>
<td>0.0003</td>
<td>1</td>
<td>No</td>
</tr>
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</table>

**Significant Questions:**

<table>
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<tr>
<th>Question</th>
<th>Parent Yes</th>
<th>No</th>
<th>Total</th>
<th>%</th>
<th>Other Yes</th>
<th>No</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>8</td>
<td>22</td>
<td>30</td>
<td>27/73</td>
<td>67</td>
<td>65</td>
<td>132</td>
<td>51/49</td>
</tr>
<tr>
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<td>18</td>
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<td>31</td>
<td>58/42</td>
<td>74</td>
<td>53</td>
<td>127</td>
<td>58/42</td>
</tr>
</tbody>
</table>

A chi-square analysis of responses from Parents versus Members of Parliament, Ministry of Education, Administrators, and Secondary and Primary Teachers, indicated that the following was significant:

**Question #3 - The opinions of parents are different**

- Parents - 27% Yes 73% No
- Others - 51% Yes 49% No
CONCLUSIONS AND RECOMMENDATIONS

a) CONCLUSIONS:

It was concluded that computer education has progressed to a relatively high level in Bermuda. In comparison to the development in Halifax, Nova Scotia and the Government schools of Australia, Bermuda’s system appears to be more advanced. Computer education in the Government schools of Bermuda is autonomous, with its own curriculum and separate from the mathematics department. It is a programme which begins in primary school and continues into secondary school for four of the five years (this may vary for some of the secondary schools). Students are able to take courses in literacy, programming, and applications, and are well prepared to continue a career in computers at the college level. There is also a high involvement by Government to ensure that all schools are adequately equipped. This was indicated by the move to standardize all schools with similar hardware and software, throughout both the primary and secondary schools. All primary schools are furnished with Apple computers and share similar programs such as "Writing to Read". In secondary schools, IBM computers are the standard, and all schools teach the same literacy course and use "Microsoft Works" for teaching applications. This allows for standardized testing throughout the system and emphasizes the goal of computer literate secondary students.
There appears to be a congruency throughout the system, and as was suggested by a member of the Department of Education, this was due to the open channels of communication which had been established from the beginning. Teachers who are members of steering committees meet regularly with members of the Department and the curriculum committee, and open dialogue is evident. This ability to communicate has surely contributed to the progress of computer education in Government schools.

An essential aspect of this study was to determine whether the aims and goals of the Ministry of Education were being met, and that has been determined to be true. Computer literacy is a required course for all secondary students, and since computer exposure begins at nursery school and continues on through primary and secondary school, all secondary students may be considered "literate".

There were several areas where differences of opinion were noted in the questionnaire responses. A chi-square analysis of responses from the government sector versus the private sector, revealed that the responses differed significantly for questions number twelve and twenty (chart page 55).

From the analysis it may be concluded that the administrators and teachers of the private schools in question, do not
place the same emphasis on computer education as do those members of government schools. The standardization of computers (tested at .05) was not considered as important for the private schools (68% Yes government - 51% Yes private). Computer education did not have the same importance for the private schools as it did for government schools (tested at the .05 level, but found significant at the .001 level) as indicated by the responses as to whether computer studies should have the same importance as mathematics, English or science (66% Yes government - 45% Yes private).

When considering those questions which differed significantly within the government sector, questions number two, twenty-two, and twenty-six were tested at the .05 level but found significant at the .001 level, and questions number thirteen and twenty-seven were found significant at the .01 level (section III, p. 57).

From the level of response it was difficult to determine why Parliamentarians and members of the Ministry of Education would have greater use of computers at home compared to the other respondents within the group. There is a difference in the responses to three of the four questions tested (section III, p. 59), but whether this is due to the influence of a computer at home, is discussed further in the conclusion.
Parliamentarians and Members of the Department of Education responded positively as to whether or not the computer curriculum should be based on that of another country (section III, p. 58). Since the PM's represent the two major decision makers within the system, the influence of computer development in other countries (The United States, Canada, and Great Britain), will surely be realized.

The controversial topic of whether teachers should have access to the BSSC exams prior to the actual examination, will not be resolved quickly. The ASPP group, whose greatest numbers lie with teachers, indicated overwhelmingly in favour of this access (section III, p. 58). Some progress in this direction has been made this school year (1989-90), for teachers now have access to the BSSC exams of the previous year.

The ASPP group indicated a definite need for a central computer room, whereas the responses from PM group showed less favour (section III, p. 58). The computer program was designed such that classes would be sent to a specific room in a school. Each form class (class within a grade level) would therefore have all computer facilities provided in the one room, as in the case of a science class in a science laboratory.
An analysis of question number twenty-seven on page seventy, namely whether funds should be allocated for daytime maintenance of equipment, indicated a difference of opinion between the two groups (section III, p. 58). Possibly the positive responses from the ASPP group will help influence the case for the host school and the daytime teacher, who in turn will receive more support.

Although hypothesized, there did not appear to be any significant difference in the responses between the PM group and the ASPP group concerning whether it was acceptable to use software to help students learn a specific topic in mathematics (section III, p. 59, #7). Use of a computer at home for the PM group did not produce any apparent bias on their part with regard to the response to this question.

There appeared to be a significant difference between the PM and ASPP group concerning whether computer studies should be required for all secondary students and whether all secondary students should be computer literate (section III, p. 59). The difference may not be directly associated with the familiarity of computers at home, since in both cases the positive responses favour those who had less computer usage (PM 63% vs. ASPP 83%, PM 63% vs. ASPP 88%). Further statistical analysis would be required to establish whether the difference was due to computer familiarity.
Another hypothesis tested, was whether parents' opinions differed from the other respondents (section III, p. 60). The variation, found in one of the questions, dealt with the issue, at what age should children be exposed to computers. There was some disagreement over computer exposure beginning at age five years. As indicated in the explanation of the formation of this question (section II, p. 43), this result coincides with what was previously stated by some parents.

Opinions of Members of Parliament and the Ministry of Education varied significantly from school administrators, primary and secondary teachers, and parents in several areas. Overall, there was general agreement amongst all respondents, and the areas of doubt could be better investigated in a future study. The few disparities suggest that the original hypothesis (PM's would differ from ASPP's) was unfounded, and that agreement is more prevalent than disagreement.

Due to the level of responses within the government sector, generalized conclusions cannot be established. The results may be regarded as "true" for those who responded, but not necessarily "true" for the entire population of both groups.
b) **RECOMMENDATIONS BASED ON THE OPINIONS EXPRESSED IN THE RESULTS**

Some recommendations seen as fitting with respect to the opinions expressed in the results (chart page 63) of the questionnaire are:

1. After one year of Computer Literacy, secondary students should have a choice with regard to any future studies in computers. This choice should include academic and business computer studies.

2. Computer Assisted Instruction and software for "drill and practice" should be available in all subject areas where required.

3. All computer hardware/software should be standardized throughout the primary and secondary schools. All schools should strive to have a central computer room and to furnish each classroom with at least one computer.

4. The computer curricula of other countries should be studied and if strong points are discovered, then these points should be incorporated into the Bermuda computer curriculum to overcome any weaknesses.

5. Reimbursement consideration should be made for those teachers who "successfully" complete computer related studies at the Bermuda College or at one of the universities at the American Naval Station.
6. Consideration should be given to the computer teacher having direct input into the number of students in a computer class based on the number of computers available.

This study will hopefully reinforce the fact that the philosophy, goal and the aim are well in line with other systems, or slightly advanced. The several recommendations suggested are ideals, and if incorporated, would only make an already good working system, better.
APPENDIX I QUESTIONNAIRE: PLEASE PLACE AN "X" IN THE APPROPRIATE SPACES

1. GROUP
   a) Parliamentarians ______
   b) Ministry of Education ______
   c) School Administration ______
   d) Teacher (primary) ______ Teacher (secondary) ______
   e) Parent ______

2. Do you have the use of a computer at home?
   a) Yes ______ b) No ______

3. At what age should children be exposed to computers?
   a) Under 5 ______ b) Ages 5-11 ______
   c) Ages 11-16 ______ d) Never ______

4. What is your opinion on the effect of computer exposure to school children ages 5 to 11 years?
   a) Very positive effect ______ b) Good effect ______
   c) No effect at all ______ d) Negative effect ______
   e) Very negative effect ______

5. Should Computer Assisted Instruction be applied to reading, writing, and mathematics?
   a) Yes ______ b) No ______

6. Will the computer replace the teacher as a means of instruction?
   a) Eventually ______ b) Partially ______ c) Never ______

7. Would it be proper for a teacher to suggest that a student sit at a computer with software, titled FRACTIONS, to help him learn that specific topic in mathematics?
   a) Acceptable ______ b) Not acceptable ______

8. How many students should be seated at one computer?
   a) One ______ b) Two ______ c) Three ______

9. Who should purchase computers for the schools?
   a) Government (through taxes) ______
   b) Schools (through fund raising) ______

10. Should all student computing be educational with specific goals?
    a) Yes ______ b) No ______
11. Should there be a standard type of computer used in all primary schools?
   a) Yes _____  b) No _____

12. Should there be a standard type of computer used in all secondary schools?
   a) Yes _____  b) No _____

13. Should there be a central computer room in all schools?
   a) Yes _____  b) No _____

14. Should each classroom have at least one computer?
   a) Yes _____  b) No _____

15. What should the annual budget be for the purchase of computer hardware and software for all government schools?
   a) $10,000 to $100,000 _____
   b) $100,000 to $200,000 _____
   c) $200,000 to $300,000 _____

16. Should computer studies be required for ALL secondary students?
   a) Yes _____  b) No _____

17. At what level should computer literacy be introduced to students?
   a) Primary _____  b) Secondary _____

18. Should all secondary students be computer literate?
   a) Yes _____  b) No _____

19. Should we offer both academic and business computer studies in our secondary schools?
   a) Yes _____  b) No _____

20. Should computer studies have the same importance as mathematics, English, or science?
   a) Yes _____  b) No _____

21. Should teachers be assisted financially in taking courses offered by the Bermuda College in computer studies?
   a) Yes _____  b) No _____
22. Should we base our computer curriculum on that of another country?  
   a) Yes ______  b) Partially _____  c) No ______

23. Should students who select computer studies as an option in their fourth year be REQUIRED to take this course in their fifth year, or should it also be optional?  
   a) Required ______  b) Optional ______

24. At present, students in secondary school are required to take computer studies for two years. If after one year, they find that this course is not to their liking, should they be allowed to discontinue computer studies?  
   a) Yes _____  b) No _____

25. Since many students pursue computer application courses after secondary school and very few pursue courses in programming, should there be in fifth year:  
   a) More application and less programming? Yes _____ No _____
   b) Choice between application/programming? Yes _____ No _____
   c) No programming, only applications? Yes _____ No _____
   d) No change from the present arrangement? Yes _____ No _____

26. Should all teachers of computer studies have access to the BSSC exams prior to the sitting of these exams, or should the situation remain as is, available only to the computer committee?  
   a) Access ______  b) No access ______

27. Should funds collected from evening adult computer classes, which are held in our schools, help contribute to the repair, upkeep, general maintenance, and purchase of computers used during the day?  
   a) Yes _____  b) No _____

28. Should the computer teacher have direct input into the school timetable, as to the number of students in a class and how many classes per week for each level of computer studies?  
   a) Yes _____  b) No _____
APPENDIX II

QUESTIONNAIRE (PRIVATE): PLEASE PLACE AN "X" IN THE APPROPRIATE SPACES

1. GROUP:
   a) School Administration ______ Teacher (primary) ______ Teacher (secondary) ______
   c) Parent ______

2. Do you have the use of a computer at home?
   a) Yes ______ b) No ______

3. At what age should children be exposed to computers?
   a) Under 5 ______ b) Ages 5-11 ______ c) Ages 11-16 ______ d) Never ______

4. What is your opinion on the effect of computer exposure to school children ages 5 to 11 years?
   a) Very positive effect ______ b) Good effect ______ c) No effect at all ______
   d) Negative effect ______ e) Very negative effect ______

5. Should Computer Assisted Instruction be applied to reading, writing, and mathematics?
   a) Yes ______ b) No ______

6. Will the computer replace the teacher as a means of instruction?
   a) Eventually ______ b) Partially ______ c) Never ______

7. Would it be proper for a teacher to suggest that a student sit at a computer with software, titled FRACTIONS, to help him learn that specific topic in mathematics?
   a) Acceptable ______ b) Not acceptable ______

8. How many students should be seated at one computer?
   a) One ______ b) Two ______ c) Three ______

9. Should all student computing be educational with specific goals?
   a) Yes ______ b) No ______

10. Should there be a standard type of computer used in all primary schools?
    a) Yes ______ b) No ______
11. Should there be a standard type of computer used in all secondary schools?
   a) Yes ______ b) No _____

12. Should there be a central computer room in all schools?
   a) Yes ______ b) No _____

13. Should each classroom have at least one computer?
   a) Yes ______ b) No _____

14. Should computer studies be required for ALL secondary students?
   a) Yes ______ b) No _____

15. At what level should computer literacy be introduced to students?
   a) Primary _____ b) Secondary _____

16. Should all secondary students be computer literate?
   a) Yes ______ b) No _____

17. Should we offer both academic and business computer studies in our secondary schools?
   a) Yes ______ b) No _____

18. Should computer studies have the same importance as mathematics, English, or science?
   a) Yes ______ b) No _____

19. Should teachers be assisted financially in taking courses offered by the Bermuda College in computer studies?
   a) Yes ______ b) No _____

20. Should we base our computer curriculum on that of another country?
   a) Yes _____ b) Partially _____ c) No _____
APPENDIX III

Explanation of questionnaire terminology

Many of the questions required some explanation of computer terminology and of expressions and wording used. Since the questionnaires were distributed to several different groups, it was assumed that not all participants were knowledgeable of terminology. Therefore, an explanation sheet was distributed along with the questionnaires. This sheet was by no means intended to relay precise and complete definitions of terminology, rather, it was a supplement to the questionnaire to help explain wording and expressions which may be unfamiliar to the non-computer literate respondent.

Question #5: COMPUTER ASSISTED INSTRUCTION is a subject tutorial using a computer. For example, a tutorial on fractions allows the user to better understand the concept of fractions by using visual examples. The programs have built-in scored tests, and the opportunity to review the topics repeatedly.

Question #7: The term SOFTWARE refers to computer programs which are loaded into the computer. An example would be a computer game.

Question #10: The question, "SHOULD ALL COMPUTING BE EDUCATIONAL?", suggests that game playing, for example, is a non-educational use of a computer.

Question #11-#12: Not all schools use the same brand of computers. Brand names include IBM and APPLE, and many of the models of IBM and APPLE differ, being newer and older versions of the same machine.

Question #15: Computer HARDWARE refers to the computers, the screens (monitors), the diskettes, the tapes necessary to load programs, and other touchables, such as printers.

Question #17: Students take an introductory course in Computer Literacy in secondary school. This introduces them to computer terminology, history, theory, and programming in BASIC and LOGO.

Question #19: Secondary school computer courses tend to stress the academic, concentrating on the theory of how diskettes and tapes are read, and programming. APPLICATION courses tend to relate directly to business, with courses such as word processing (office typing using computers), databases (entering huge amounts of information, such as in a telephone book, and having this sorted), and spreadsheets (a form of bookkeeping and accounting done on the computer, replacing the ledger book).
Question #22: The COMPUTER SYLLABUS is the course of study we are now using here in Bermuda. The program is based on the needs of our students and what is felt necessary for them to have as a foundation, when they leave secondary school.

Question #27: BSSC refers to the Bermuda Secondary School Certificate. This certificate is granted to those students who successfully complete a standard exam, which is administered to students of all government secondary schools. The intention is to have this exam accepted by all institutions of higher learning, such as the Bermuda College.
APPENDIX IV

LETTER OF INTRODUCTION TO QUESTIONNAIRE PARTICIPANTS

To whom it may concern:

As a graduate student and school teacher in a Bermuda government school, I am very interested in how computers are used in education. The topic of my proposal, "THE DEVELOPMENT OF COMPUTER EDUCATION IN THE BERMUDA SCHOOL SYSTEM", is a study which has not been previously undertaken. It is especially relevant to me, for I am a teacher of computer studies and a member of the computer committee. It is therefore very important to obtain greater insight into the development of computers in our education system, and the direction in which their usage is heading.

The purpose of my research is to investigate:

1) The development of computer courses in Bermudian schools

2) Use of computer courses in Bermudian schools:
   a) Computer applications in the primary school
   b) Computer syllabus for the primary school - years 1 to 5
   c) The use of computer assisted instruction in primary and secondary schools

3) The present status of computer education in Bermudian schools:
   a) The student/computer ratio per school
   b) The brand names of computers in use
   c) The software available for these computers

4) The future direction of computer education in Bermuda as perceived by:
   a) Parliamentarians and the Ministry of Education
   b) School administrators and teachers
   c) Parents of students

Therefore, I would greatly appreciate your assistance. Simply complete the two/three page questionnaire and return it, as soon as possible, in the pre-stamped, addressed envelope provided. The questions are not personal and it is not necessary to write your name and address on the questionnaire or envelope.

I look forward to receiving your comments and ideas - they will be indeed most helpful. Thank you for your time and co-operation.

Yours truly,

Gregg M. Haroun
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