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C

Editors-in-Chief
TORSTEN HUSEN
T. NEVILLE POSTLETHWAITE

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Calculators in Mathematics Education

In the early 1970s, hand-held calculators were placed on the market the world over. These devices were among the first articles manufactured for the general consumer which used the microprocessor, a tiny solid-state silicon chip no larger than this letter "M."

Today, different models with a wide range of functions are available. These range from inexpensive models that only add, subtract, multiply, and divide to programmable models that function as small computers.

Although many students and teachers now own personal calculators, they still have not received wide acceptance into the mathematics curriculum. However, the calculator has been accepted as a computational tool in many upper-level (preuniversity) nonmathematics disciplines, that is, physics, chemistry, business, and so on. At the university level, calculators are used freely by many teachers and often considered part of the expected equipment for students of science, engineering, and economics. For engineering students in the United States the calculator has completely replaced the slide rule. However, at lower grade levels there is less acceptance of the calculator in the mathematics classes. Educators in many countries do not believe that the calculator is appropriate for 13-year-olds and under. For example, in the Federal Republic of Germany, the Ministries of Education have prohibited the use of the calculator for computation in grades one through six.

In the United States, the National Council of Teachers of Mathematics conducted an extensive survey of the opinions of a broad-based sample of both professional educators and lay persons entitled *Priorities in School Mathematics* (PRISM) (National Council of Teachers of Mathematics 1981). One of the items considered in this survey was the calculator in the preuniversity mathematics classroom. The survey report suggests that there may be greater differences of opinion on the proper use of the calculator in the mathematics curriculum than on any of the other 15 items surveyed.

Textbook publishers' cautious approach to incorporation of the calculator probably reflects this absence of a consensus of opinion. Most textbooks for the 14-year-olds and older have some special problems which are marked for calculator use. However, the traditional curriculum has not been revised to accommodate the calculator. In the United States, Canada, and United Kingdom, as in other countries, there are supplemental publications available to help the teachers who want to use the calculator; however, it is still difficult and requires much individual effort on the part of the teacher to incorporate the calculator into the classroom. The calculator has had wide acceptance only for such tasks as checking answers and replacing trigonometric and logarithmic tables.

Advocates of the calculator see the following advantages: (a) word problems can use realistic data for all age groups; (b) the calculator has a positive motivation effect; (c) its use relieves the student from tedious computation; (d) development of calculator algorithms offer an opportunity to study algorithmic processes; (e) working iterated procedures can lead to a better understanding of concepts such as limits; (f) calculator tests will have to emphasize mathematical concepts and reasoning ability; (g) the ability to operate calculators is an asset on the job market; (h) the use of calculators will improve students' attitudes towards mathematics lessons; (i) with the calculator, many topics such as probability and statistics can be introduced earlier in a more meaningful manner (Suydam 1980).

Some people see the following as dangers of introducing the calculator into the mathematics curriculum: (a) regular use will result in a weakening of basic facts and paper-and-pencil algorithms for computation; (b) use at early ages may hinder development of number concepts; (c) students will become calculator dependent; (d) students will be more likely to accept incorrect answers from the calculator; (e) if students use the calculator, they will not learn to think; (f) students will need to pass various tests without calculators.

Placing the calculator in the classroom will not automatically have all the positive and negative results listed. The outcome of the calculator in the mathematics classroom is dependent on how it is incorporated into the curriculum. A re-evaluation of the global goals of mathematics education is at the core of the calculator decision. No-one can deny that the calculator is rapidly becoming an accepted and often preferred mode of computation in everyday life and business at all levels. It is not so much a question of whether calculator use will hinder performance ability of paper-and-pencil computation as it is a question of the current and future need for paper-and-pencil computation. Is it more important to know *how* to perform the long division algorithm or to know *when* to divide and how to use a calculator to obtain the answer? Such questions demand a total evaluation of the educational goals of mathematics and a massive restructuring of the curriculum which

will not occur quickly. And perhaps a slow meaningful change is most desirable.

In the meantime, consultants and teachers can help to facilitate meaningful integration of the calculator into the traditional curriculum in several ways. Examples of three possible methods are: (a) textbook supplements; (b) games and activities and (c) special problem-solving lessons.

The textbook supplement consists of a page-by-page set of instructions for the teacher. These should include supplemental problems with realistic values. The calculator is not appropriate for all mathematics lessons and, therefore, the supplement should indicate the lessons where its use is not desirable or helpful.

There are many sources of games and activities for the calculator. Also, the value of many traditional classroom games can be enhanced by the calculator. Many games help to teach basic facts and concepts. For example, the following game to aid the learning of the multiplication facts was quite successful in an Indiana (USA) public-school project with 10- to 12-year-old students (Hutton 1980). Students work in pairs, each on a different team, with one calculator per pair. First students enter a multiplication fact of their choice, say, "7 × 9." The second student states the answer verbally, "63" and then presses "=." If the calculator verifies this verbal answer, the second student's team scores a point. If not, the first student's team scores a point. They alternate positions. The team with the most points wins. Students can use problems to which they do not know the answer.

The same project that used the above game also had some success with a special problem-solving lesson. Each week the teachers were given an overhead transparency with the problem format and a teacher's instruction sheet. Students used their calculators to solve the problem. The topics of these special problems were relevant to the students' current interests. For example, the 500 Mile Auto Race is run in May in Indianapolis, Indiana. At this time, one of the lessons concerned the speeds in the race. The lesson involved ratio, proportions, and units. The students were both interested and motivated to find the solutions. With the aid of the calculator they were able to quickly solve a meaningful application of ratios and proportions and thereby reenforce their understanding of these concepts.

The calculator can be an asset to the mathematics curriculum if it is used properly. It will require work by both curriculum specialists and classroom teachers to effect changes in educational attitudes by demonstrating its positive aspects. Undoubtedly, overwhelming general use of calculators will slowly force the schools to recognize their importance. When calculators are incorporated into the mathematics curriculum, hopefully it will be in a manner befitting the technology that developed them.

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L. A. Hutton

Cameroon: System of Education

The United Republic of Cameroon lies in a triangular wedge between West and Central Africa. Its rugged terrain, covering around 475,000 square kilometres (183,500 square miles), ranges in climate from Saharan desert in the north to tropical rain forest in the south, making communication extremely difficult.

The population of eight million in 1981 was distributed chiefly in small villages which composed over 200 ethnolinguistic communities—representatives of nearly every group in Africa.

The nation's boundaries, as well as its name, are a product of European colonialism, which ended in 1960–61, when the territory achieved independence. Since 1571, when Cameroon first appeared in recorded history, Portuguese, Spanish, Dutch, English, and French explorers and traders came to trade along the coastal estuaries of the River Wouri where the waters abound in prawns or *cameroes*, the Portuguese word from which Cameroon derived its name. By the late-eighteenth century, when the slave trade reached its peak, the English not only held supremacy but also provided a lingua franca for the diverse tribes of the area. Pidgin English became not only the language of business between natives and foreigners, but also the medium of communication among many ethnic groups. It remains today the medium of evangelization, especially for the Roman Catholic Church.

During the period 1884–1914, Germany controlled the region and determined the general boundaries that define the present republic. When Germany lost its African colonies after the First World War, the region was divided between France and the United Kingdom as a League of Nations mandate which continued as a United Nations trust after the Second World War, with France assigned the eastern and northern three-quarters and Britain the western quarter.

The British administered their portion as part of their neighbouring Nigerian colony and set up schools in which pupils were taught in English. The schools were operated predominantly by religious bodies. The French established schools in their territory simi-

lar to those in France, with the French language as the medium of instruction.

In 1960, French Cameroon became independent. After a plebiscite supervised by the United Nations in February 1961, the southern part of British Cameroons opted to reunite with the new Republic of Cameroon while the northern part remained with the Federation of Nigeria. The new constitution of the Federal Republic of Cameroon in 1961 declared English and French as the official languages. Since then, the development of bilingualism (French–English) has become the greatest hope for national unity and the greatest problem in education at all levels of the school system. In 1972, the governance structure was changed to that of a united republic.

1. Goals of Education

The principal ambitions of the nation's educational leaders have been to extend educational opportunities to the entire populace, to achieve national unity, and to supply the trained personnel identified in the country's sequence of five five-year national-development plans (1960–85). The main objectives of the plans in increasing productivity in all sectors of the economy have been largely reached, as is reflected in the per capita gross national product (GNP), which increased from US$310 in 1976 to US $500 by 1980. Cameroon is, therefore, considered to have one of the most rapidly developing and balanced economies in West Africa.

Occupations continue to be chiefly in the primary sector of the economy—agriculture, fishery, and animal husbandry—with such cash crops as cocoa, coffee, cotton, groundnuts, palm, tea, and rubber accounting for about 36 percent of the gross domestic product (GDP). Modernization of peasant methods of cultivation has again been emphasized in the fifth five-year plan (1981–85), and it is here that the importance of education has been stressed. The development of functional literacy has been seen as one way to equip the rural population for acquiring the knowledge and techniques that will make their efforts more productive. For this reason adult literacy classes are often integrated with other forms of training given to farmers by cooperatives and agricultural extension personnel. In one of the most ambitious educational experiments, labeled IPAR, attempts have been made to reform the curricula of primary schools and teacher training so as to orient school work towards a better understanding of rural life. Thus, educational development has been seen as the greatest stimulus for improved agricultural productivity.

2. Structure and Size of the Education Effort

Primary schooling (ages 6–12) remains the only basic education for most of the literate population. Less than 25 percent of primary-school leavers continue to secondary school (ages 11–18), and less than 5 percent of those completing secondary school go to university. By 1970, the proportion of primary-age children in school had reached 70 percent, compared to only 15 percent in 1960. The demand for schooling far exceeds the education effort, and education is everywhere the principal concern of parents and the government.

The French and the British systems of education continue (Fig. 1). The francophone system comprises

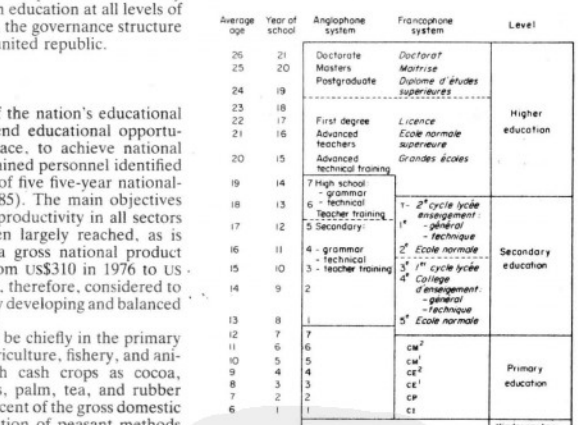

Figure 1
Structure of schooling in Cameroon

6 years of primary schooling followed by a 4-year plus a 3-year lycée-type secondary-school system. In the two anglophone provinces of the country, the duration of primary schooling is 7 years from age 5 plus. This is followed by a 5-year plus 2-year secondary-school cycle. Both systems merge into one national system of higher education for both anglophones and francophones. French–English bilingualism is a requirement for academic work at this level.

Since one of the major goals of the school system is to promote national unity, Cameroon's first university was established as a bilingual institution as the first step in creating a unified structure of schooling for all Cameroonians.

Teaching two foreign languages as the country's

Table 1
Expansion of enrolment from 1965–66 to 1980–81

Year	Nursery	Primary	Secondary—general	Secondary—technical	Secondary—normal	University
1965–66	—	742,000	29,000	—	—	—
1966–67	—	774,000	33,000	—	—	—
1970–71	—	923,000	56,000	17,400	—	2,600
1975–76	—	1,123,000	105,000	31,000	—	7,200
1978–79	32,000	1,254,000	147,000	45,000	1,700	10,600
1979–80	37,000	1,303,000	154,000	52,000	1,900	10,300
1980–81	41,000	1,380,000	169,000	56,000	2,100	10,400

Source: Ministry of Education 1966–81 *School Statistical Yearbooks*. Ministry of National Education, Yaounde, Cameroon

official media of communication is the major function of schools. Nevertheless, the survival of Cameroon's native languages and the hope of deriving a lingua franca from them has not been forgotten. In the cities of Yaounde and Douala, the teaching of some Cameroon languages (Douala, Bassa, Ewondo, and Bamelike) has been tried with some success. There are a number of linguistic-research projects being carried out, directed towards preparing manuals for the formal teaching of Cameroon languages. The summer Institute for Linguistics is doing intensive research in this area (*Societé Internationale de Linguistique* 1981).

Since independence, educational expansion has been rapid (see Table 1 and Figs. 2 and 3). In addition to the goals outlined in Sect. 1, educational policies have also been aimed to achieve regional balance. One of the major targets of the first and second five-year development plans (1960–65, 1966–70) was to reduce regional imbalance in educational expansion, bringing the northern and eastern sections of the country up to the more advanced levels of school enrolment found in the southern and western sections. In addition, the government is seeking to enrol a higher percentage of girls and of rural children.

3. *Finance and Administration*

In a highly centralized system modelled on the French schooling structure, the Ministry of Education has complete jurisdiction over all levels of education, ranging from setting goals established by national policy to issuing instructions on minute functions of the educational machine. Important agents of the central authority are the school inspectors who prepare programme changes, supervise teaching, determine the suitability of textbooks, and organize the examinations for the primary-school-leaving certificate, secondary-school diplomas, and teacher-training certificates.

There is a sharp distinction between state-owned and private schools. In 1977, over 60 percent of the nation's 5,000 primary schools were state owned and nearly 40 percent privately operated. Of the 300 secondary schools, 54 percent were state owned, while at the tertiary level all institutions were under the government's administration. Education in government institutions is free of charge. Private schools are fee-paying, although the majority of private schools receive government subsidies to cover teachers' salaries.

The proportion of the recurrent national budget devoted to education continues to be rather high: 20 percent in 1981–82 and 40 percent in 1982–83. Since

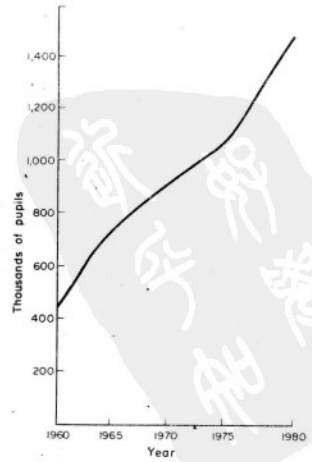

Figure 2
Primary-school enrolment 1960–80

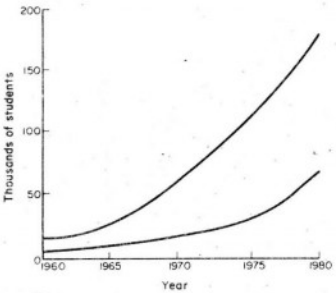

Figure 3
Secondary-school enrolment 1960–80

salary increases required by the rising cost of living continue to take up 85 percent of the education budget, little money is left for educational innovations aimed at improving the quality of education.

Two further sources of educational finance are parents and local communities or associations that provide scholarships and funds for equipment and buildings.

4. Curricula

The central issue in curriculum development is how to discard the French and British heritages and evolve school programmes which are better adapted to the nation's needs.

The IPAR project (see Sect. 1) at the primary level has aimed not only at introducing a high dose of practical work into the curriculum, but also at making the school and its teachers catalysts of rural development (Lallez 1975, Yembe and Kale 1980).

At the secondary level, the bilingual school experiment sought to solve the thorniest of Cameroon's educational problems by aiming to produce students equally fluent in French and English (Yembe 1979).

In higher education, one of the most noteworthy efforts to depart from the traditional organization of a university faculty of medicine has involved training a variety of medical and paramedical personnel in the same institution. Furthermore, one of the university centres is to be developed into an American-type land-grant college to stimulate the development of agriculture in the region surrounding the university.

However, despite these reforms, the present school curricula remain largely a replica of those existing in colonial times.

Alongside the formal school system, nonformal programmes have been created, some designed to engage school leavers in practical-skills training and others intended especially for the interests of women. Both the Department of Community Development and Christian church organizations have spread programmes in domestic science and adult literacy to remote villages. Farmer cooperatives have taught modern production skills and ways of distributing agricultural products.

In the Koranic schools, which are found primarily in the northern sectors of the country where there is a large Moslem population, traditional Islamic curricula continue to dominate. There are also Anglo–Arab and Franco–Arab schools which combine the secular primary-school programme with elements of the Koranic school, teaching Arabic alongside either English or French.

5. Examinations

Class promotion, examinations, competitive school-entrance tests, and certificate examinations are all regulated by detailed instructions from the Ministry of Education. In the late 1970s, the scramble for places in some of the well-run nursery schools inspired some headmistresses to set selection examinations for 3- and 4-year-olds.

Throughout the system, from primary school through the university, advancement of pupils from one class to the next is determined by tests, with the pass or fail mark often fixed beforehand by regulations from the ministry. As a consequence, these tests become a significant factor in determining who stays at school and who drops out.

Likewise, certificates and diplomas, which are so important for graduates seeking employment or further schooling, are awarded chiefly on the basis of examination scores. It is not the individual institution, but rather the state, which awards certificates and diplomas under the signature of the minister of education or his representative.

6. Personnel

Despite great efforts to expand teacher-education facilities since Independence, a drastic overall shortage of trained teachers in the school system continues to exist. Mathematics and science teachers are still in great demand and expatriates in these fields are still attracted with offers of more favourable conditions of service than those granted to nationals. There is also a lack of specially trained personnel for the administration and supervision of the system. There is a tendency to appoint school administrators and inspectors from among serving teachers of noteworthy ability.

Since 1960, the government has mounted a variety of programmes to solve the shortage of educational personnel. An early effort to staff primary schools

consisted of drawing new teachers from the ranks of primary school leavers, who in 1976 constituted over 51 percent of the nation's 22,000 primary teachers. The trend since 1970 has been to replace such personnel with untrained secondary-school leavers and to operate a correspondence course aimed at encouraging unqualified teachers to upgrade their skills.

By the early 1980s, Cameroon administered eight training colleges enrolling 2,000 students, with an annual output of about 300, far short of the annual need for 1,800 new teachers.

7. Educational Research

The three chief sources of research on education in Cameroon are (a) individual scholars in universities, principally in the United States, the United Kingdom, and France; (b) international organizations in cooperation with the Cameroon government; and (c) three educational research institutes within Cameroon. The three institutes demonstrate the government's faith in the use of research findings as a basis for policy decisions. But it will be some time before these organizations produce the type and volume of studies to justify such faith. Lack of trained personnel and insufficient funds are among the problems which have limited the impact of the institutes.

8. Major Problems

The demand for education at all levels far outstrips the supply, and the greatest problem for policy makers is to convince parents and youths that desired educational provisions cannot be offered to everyone. Thus, to ensure equity and avoid political conflict, the Ministry of Education must carefully regulate the selection of candidates for schools at all levels.

A second problem is that of improving educational quality where there may be 100 children seeking to learn in a classroom although 50 pupils per class is the official standard. The problem of shortage of suitable books and equipment also needs to be solved if quality of learning is to be raised.

A third problem is that of funding. Even with 20 percent or more of the recurrent national budget dedicated to education, and with parents making great sacrifices to pay school expenses, funds are still short of what is needed.

But perhaps most difficult is the problem of language—the medium of instruction in the schools. At a time that many nations are adopting a native tongue for school instruction, Cameroon continues to use English and French. How to solve this problem, particularly when English and French are seen as necessary for continued socioeconomic development, is not yet clear.

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O. W. Yembe

"Campaign": A Technique in Adult Education

A technique in adult education first used in the 1940s (the radio forum) has been given a new significance and a new name: the radio learning group (RLG) campaign. It is a nonformal education strategy allowing citizen participation and consultation on various national issues. It is a systematic means for communicating information on major national issues to large numbers of people. It brings together people who would not normally participate in organized educational activity for a short-term programme of group study, often in people's homes. In some cases it serves to mobilize mass participation in community action.

The programme lasts from five to ten weeks and deals with a topic of major importance for very large numbers of people. The participants are organized

into groups of between 5 and 20 by a network of field workers who recruit, train, and support the people in these groups.

Each learning group meets once or twice a week over the campaign period under the leadership of a trained group leader. Meetings involve listening to a specially prepared radio programme, studying the supporting printed materials, discussing this information and the issues involved, agreeing on an appropriate action (to be taken by group members), making comments, and raising questions on the issues (feedback). These are sent to the campaign organizers for use in the formulation of policy (consultation).

Each radio learning group operates without a subject expert. The RLG leader is a group organizer and discussion facilitator, rather than a "teacher" in the usual sense. The source of learning comes from the study materials and the experience and insights of members who share in the discussion. The group leader's job is to organize the meeting and lead the group through the various learning steps (e.g. radio listening, study guide reading, and discussion).

The primary aim of an RLG campaign is to promote awareness and to help people understand major issues, policies, or programmes. The underlying rationale is that participation in development requires that people understand what is going on around them. Another common aim is often to get people's views on a new public policy, and in this case, participation requires that people not only be told about new programmes and policies, but requires that they are consulted and involved in shaping them. Some campaigns mobilize local collective action.

In conception, the radio learning group combines the study circle idea (i.e. locally controlled discussion groups) with the possibilities of mass media as a focus and support for study and discussion. It is different from a radio listening group in which information is passively assimilated. The RLG starts with information from a central authority, then discusses and debates these ideas and decides on its own response to it.

This combination of mass media and "self-help" group study is of particular value in the Third World. It enables an essentially uneducated populace to have access to expert knowledge. They begin to understand the issues, without a network of suitably qualified teachers. The radio provides the information which would normally be provided by a teacher. The group study helps people analyse this information and relate it to their own lives.

Radio learning group campaigns depend upon a number of preconditions. There must be active political support from the national leaders and the study topic must be of significant interest to engage the attention of large numbers of people. There must be sufficient financial resources (e.g. the 1976 campaign in Botswana cost US $500,000) and the high-priority attention of all who are involved. Organization requires the collaborative effort of several groups (e.g. broadcasters, adult educators, extension networks, and party networks). The recruitment of group members and group-leader training can be organized by existing networks of field workers (e.g. agricultural extension workers and trained health educators). Sufficient time has to be allowed for all of the preparatory tasks before the campaign begins.

An RLG campaign is a modification of an educational method which was first developed and used in Canada. Farm Forum (1942–1962) and Citizens' Forum (1944–1962) were radio programmes which were organized for farmers and urban groups respectively. This method was so successful that several Third World nations took up the idea, among them Tanzania and Botswana. However, the latter decided to use the radio learning group idea in a campaign format, focusing on one major national issue over a 5 to 10 week period.

They argued that a year-round, continuous programme was not suitable for their adult population. They also maintained that a short-term campaign would be easier to organize and would attract a much larger audience. Many people who would not take part in an ongoing programme covering a wide range of themes would, and did, participate in short-term campaigns on topics of major national importance. For example, the 1976 "Consultation" campaign in Botswana (on the government's land reform proposals) involved one in six adults in the country (55,000 participants) in over 3,500 radio learning groups which produced 25,000 feedback reports giving their reactions to the proposals. This grass-roots feedback resulted in significant changes to the government's programme (Kidd and Etherington 1978).

In Tanzania the 1973 "Action" campaign on health mobilized over two million participants in over 100,000 radio learning groups which carried out over one million community health projects: destroying mosquito-breeding areas, constructing toilets, digging wells, and boiling/filtering water (Hall 1978).

Radio learning group campaigns have been organized in the Third World in China, Tanzania, Botswana, Somalia, and Nicaragua. Campaign topics have included: sanitation and preventative health (China, Tanzania), civic education (Botswana, Tanzania), land tenure reform proposals (Botswana), and reafforestation (Tanzania). Study group campaigns have also been organized in Europe and North America. Two recent examples are a Swedish consultation in 1980 on the nuclear power issue and a Canadian study campaign in 1979 on economic and political issues.

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R. Kidd; B. L. Hall

Canada: System of Education

There is no such thing as "the Canadian educational system". Education is, by law, a provincial responsibility. Section 93 of the British North America Act (BNA) states: "In and for each province, the legislature may exclusively make laws in relation to education". Canada therefore has 12 educational systems, one for each of the 10 provinces, one for the Northwest Territories, and one for the Yukon Territory. Although the two territories are not constituted as provinces, the federal government has delegated somewhat similar powers with respect to education as those held by the provinces.

Geographically, Canada is the second largest country in the world, next only to the Soviet Union. By population, it is among the smallest, having only 24 million people in an area of 9,976,185 square kilometres (3,851,809 square miles). Campbell (1982) provided an almost poetic description of Canada when he wrote:

> Extending 4,500 miles from east to west, its shores are washed by three oceans. A single electoral district, Nunatsiaq, 860,000 square miles, extends through no fewer than four international time zones; another of two square miles, Laurier, serves 92,000. Immense inland plains, snow-bound mountains, vast expanses of tundra and rock verge on one another. Part of this land produces delicate fruits; others are eternally ice-bound. Well endowed with the resources the world needs, some of its regions are immensely rich while others, their full potential undeveloped, are less well off. From its colonial beginnings, two language groups, French and English, have predominated. Yet it is today a land of many tongues, many colours, many proudly recollected ethnic histories. (Campbell 1982 p. 839)

Because of its immense size and the fact that education is a provincial responsibility, geography, politics, economics, and other factors have all influenced education in varying degrees. Gayfer (1978) wrote:

> The education systems in the different provinces have much in common, although each has unique features. Diversity stems in part from the traditions and aspirations of the founding settlers in each province and from differences in economy, geography and size of population. Scottish educational practice (more so than English or American) had a strong early influence on English-speaking Canada while the traditions of education in France were followed in the French-speaking province of Quebec. (Gayfer 1978 p. 10)

A changing Canadian society has also influenced education in Canada. One hundred years ago, Canada was two-thirds rural. It is now two-thirds urban. Improved transportation and the new and constantly improving technologies have brought the country close to being able to truly offer equality in educational opportunities to all citizens.

In 1891, the then nine provinces (Newfoundland joined the Confederation in 1949) decided an organization was needed to facilitate sharing of information on educational concerns across Canada. The Dominion Education Association (now the Canadian Education Association) was then born and held its first conference in Montreal in 1892. But while the Canadian Education Association, and other educational organizations, have done much to provide for a sharing of information, which has led to the Canadian educational systems at least strongly resembling each other, families who move from province to province still complain that their children suffer, and often "lose a year" because of the great differences in the systems of education. There are no "national goals" for education in the country, nor is there a national standard curriculum.

A changing population is also influencing the educational systems in Canada. Figures released by Statistics Canada in July 1982 show that in Canada the proportion of older people is rapidly increasing. This trend strengthened between 1976 and 1981 due to an actual decline in the number of children being born. The postwar baby boom meant school systems across Canada had to deal with problems of rapid expansion in the 1950s and 1960s. Those were the years when a graduating teacher was as sure of a waiting job as a graduating computer-science student is in the 1980s. In the 1970s, the problem was, and still is in the 1980s, the reverse. Student enrolments have fallen and are still falling. The young people born during the postwar baby boom are now in their childbearing years, but this group is reproducing at lower rates than its predecessors. As Statistics Canada says: "The recent widely discussed surge in the popularity of parenthood may be overstated. In 1981, the youngest age group, 4 and under, was 7.3 percent of the

population, compared to 7.5 percent in 1976 and 8.4 in 1971 even though the proportion of young females of child-bearing age has actually increased during the period" (Statistics Canada 1982 p. 1).

At the other end of the life cycle, the group of 65 years of age and over increased by 17.9 percent between 1976 and 1981, representing 9.7 percent of Canada's total population in 1981, compared to 8.7 percent in 1976.

School boards across Canada have coped, and are coping, with declining enrolment in a number of ways. Many schools have been closed and teachers released from service. The usual procedure followed when teachers must be released due to an insufficient number of students is "last in, first out". This, of course, creates the problem of an ageing teaching population. To try to offset this, quite a few school systems have developed early-retirement programmes and various other incentives so that there will be room for some new, young teachers each year. Teaching positions are still, however, extremely scarce, with the exception of some isolated northern areas.

Canada has a mainly urban population. Immigrants, many of whom do not have English as their first language, tend to settle in the large cities and this presents an additional set of problems for educators in Canadian cities. The city of Toronto, for example, has an elementary and secondary student enrolment of nearly 80,000 (it was 110,000 in 1970). Of the 80,000 students, fewer than 50 percent have English as a first language. Canada has chosen not to be a "melting pot" and so efforts, sometimes costly, are made by city systems for immigrant children to maintain their original culture and language.

The "role of the school" is a continuing topic of discussion across Canada. In a country that is suffering from high unemployment, and in the grips of a recession, some argue that schools should concentrate on training students for occupations that now, or will, lack skilled workers. Others say that, with technology and the type of skills required changing so rapidly, the best the school can do is provide a sound basic education and an incentive to students to continue learning long after their formal schooldays have ended.

In the 1960s, money was, if not in limitless supply, at least readily available from provincial treasuries for educational purposes. The economy as a whole was in good shape then, and experiment was the order of the day. New schools sprang up almost overnight, many with "open-area classrooms" that could accommodate up to 14 classes in one wide-open space. Carpeting was laid so that students could sit or lie comfortably on the floor while doing their lessons. Team teaching was introduced, along with new curricula and continuous progress so that each child could proceed at his or her own pace to "maximum potential" without fear of failure. Literally millions of dollars were spent on audiovisual aids, especially television sets and videotape recorders, and school libraries, now equipped with more than just mere books, became known as resource centres.

Also in the 1960s, the traditional requirement for high-school students to pass final examinations set by the provincial departments of education was discontinued in most provinces. Schools were now able to set and mark their own secondary-school graduation examinations. At about the same time, the number of options a secondary-school student could select through each year of school increased dramatically, with a corresponding decrease in the number of obligatory subjects.

With declining enrolments, a worsening economy, and some doubt (rightly or wrongly) about educational standards, provincial funds for educational systems became more difficult to obtain in the relatively large amounts that had been available in the 1960s. In the 1970s, perhaps in response to shrinking budgets, perhaps in response to public pressure on provincial and local politicians, walls began to appear in open-area schools, some options were dropped in secondary schools and, some subjects reinstated as obligatory.

Not until the economy improves will local school jurisdictions be able to obtain the provincial funds they believe they need to maintain the high-quality educational systems that now exist. And even an upturn in the economy might not help very much. Parents with children in school are the strongest supporters of the school systems. As this group becomes smaller in relation to the total population, they will have less influence on the provincial politicians who control most of the money supply for education.

1. General Structure and Size of the Educational Effort

Within Canada there are elementary schools, secondary schools, special schools, private schools, community colleges, and universities. There is also schooling for Indians and Innuit, provided either in federal schools on reserves or in provincial schools with the cost being paid by the federal government.

The beginning age for school varies across the country, as does the transition from elementary to secondary school. Generally speaking, elementary school is for children aged 5 or 6 to 11 or 13, with secondary schools providing programmes for 12- or 14-year-olds to 18-year-olds.

The elementary school is usually designed to provide a basic learning in reading, writing, computation, science, social studies, music, and art. In recent years, there has been an increasing emphasis on Canadian studies, both at the elementary and secondary levels. This was probably a reaction to

various surveys that indicated Canadian students had a much better knowledge of the history and current affairs of the United States than they did of the history and current affairs of their own country.

There are several different types of secondary school in Canada, though most are "composite" and offer a wide range of academic, business, and technical courses. In some of the larger cities, vocational and/or occupational secondary schools are available for the nonacademically oriented student. With few exceptions, these lead directly to the world of work, while graduation from the composite schools may lead to employment, a community college, or to university. The enrolment figures for elementary and secondary school for 1968–69 to 1983–84 are shown in Fig. 1.

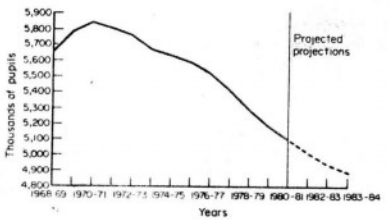

Figure 1
Total elementary and secondary school enrolment 1968/69–1983/4

Community colleges, which are postsecondary nondegree-granting institutions, were first established in Canada in the late 1960s. The growth and popularity of these institutions (which naturally vary considerably in nature across the country) have been nothing short of phenomenal (see Fig. 2). According to Gayfer (1978),

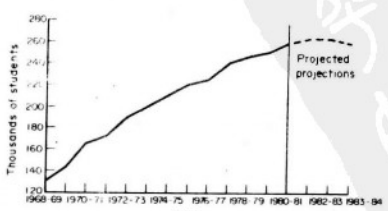

Figure 2
Full-time community college enrolment 1968/69–1983/84

In 1960–61, there were 29 institutions later categorized under the term "community college" with a student enrolment of 9,000, mostly in existing institutes of technology. The full-time enrolment in all post-secondary non-university institutions at that time—including teachers' colleges and hospital schools of nursing was 49,300.

By 1978 there were some 173 community colleges and related institutions (including hospital schools of nursing and teacher-training colleges) with an enrolment of about 247,000.

Data from Statistics Canada point out that less than one-third of the post-secondary growth is due to an increase in population. The main growth is due to increased participation. (Gayfer 1978 p. 29)

There are approximately 68 degree-granting universities in Canada. As is true with Canadian elementary and secondary school systems, geography, history, and the economy have had an influence on the development of the universities in the country. Most of the eastern universities, the first to appear, were founded by religious institutions while the western universities were established by provincial governments.

The question is sometimes raised as to how Canadian are Canadian universities. Certainly the western universities and Memorial University in Newfoundland were strongly influenced by the American state university, while others, especially those founded by religious institutions, were influenced by English and Scottish traditions. With regard to universities in Canada, Johnson (1968) wrote: "While acknowledging these European and American influences, no one could really mistake Canadian universities for either English, American, or French. Perhaps their most Canadian quality is our propensity to borrow ideas wherever good ones were to be found. While the United States may point with pride to some of the finest universities in the world, it also has some of the poorest. Canada's are closer to a norm. We have no Harvard or MIT but for none of our institutions do we need to be overly apologetic" (Johnson 1968 p. 184).

In 1976–77, university enrolment as a percentage of the 18–24 age population was 19.8 percent; in 1960–61, it was 6.7 percent. In 1981–82, there were nearly 400,000 full-time graduates and undergraduates attending Canadian universities (see Fig. 3).

In 1977–78, some 5.4 million Canadians were enrolled in elementary and secondary schools; 246,980 were in nonuniversity postsecondary institutions; 390,000 undergraduate and graduate students were in universities; and more than one million adults were taking part-time credit and noncredit courses offered by a variety of educational institutions. Total enrolment in the 1977–78 Canadian educational enterprise was about one-third of the country's total population. The educational percentage of the gross national product (GNP) in 1977

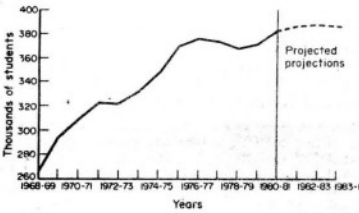

Figure 3
Total full-time university enrolment 1968/69–1983/84

was 7.9 percent, compared to 4.5 percent in the early 1960s.

School systems across the country, especially in the large urban areas, are continuing to experience a drop in full-time student enrolment. On the other hand, an increasing number of adults are taking part-time courses, some through school boards, some through community colleges, provincial correspondenee schools, universities and other educational institutions, and museums and art galleries. Many return to school to upgrade themselves or train for another occupation, especially in the rapidly developing technological fields. Figures 1 to 4 present enrolment trends.

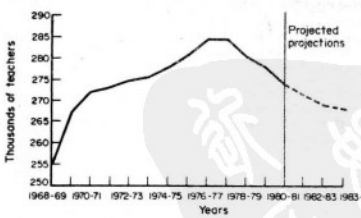

Figure 4
Full-time elementary and secondary school teachers 1968/69–1983/84

2. Administrative and Supervisory Structure and Operation

Because education is a provincial responsibility in Canada, the administrative and supervisory structure and operation varies somewhat across the country. There are many commonalities, however, and probably the best general description is provided by Gayfer (1978):

> The legal, administrative, and financial provision for public education from elementary school through university is the responsibility of the provincial government, not the local or municipal governments.
>
> Education policies are determined through a minister of education and, in some provinces, a minister of post-secondary education, who are members of the Executive Council or Cabinet, designated to that portfolio by the premier of the province. The minister is directly responsible for the management and operation of the education system during his term of office, through the department of education (in some provinces called ministry of education). The policies and powers of the government are embodied in a school or education act (or acts) and university and college acts. Other duties and obligations derive from regulations made by the minister, which are concerned with subject matter covered more generally by an act. Regulations are intended to deal with details of the implementation of principles.
>
> Generally, a department (or ministry) of education undertakes the supervision of teacher competency and the granting of teacher certificates; the evaluation of school programs; establishment of courses of study and prescription or approval of textbooks; provision of financial assistance; setting out of rules and regulations for the guidance of trustees and education officials of school boards; and generally delineating the duties of school principals and teachers. (Gayfer 1978 p. 13)

The provinces delegate certain powers and duties to the trustees (in most cases elected) of school boards. The boards are generally responsible for, among other things, school buildings and maintenance; the hiring, promotion, and dismissal of teachers; and instruction and curriculum design. Other duties and responsibilities are in turn assigned by school boards to senior professional administrative staff.

3. Finance

In 1950, total expenditures on education as a percentage of GNP were 2.4 percent. In 1960, the percentage was 4.5. It rose to slightly over 6 percent in 1965, and reached an all-time high of 9 percent in 1970. By 1975, it had dropped to 7.9 percent and in 1979 it was 7.7 percent. Expressed as a percentage of total government expenditures, in 1969 education accounted for 22 percent. Ten years later the percentage had dropped to 17 percent. During the same period, 1969–79, expenditures on social welfare rose from 18 to 23 percent.

In 1981–82, Canada spent over Canadian $25.5 billion on education. The sources of funds were: provincial and territorial governments (66 percent); local taxation (19 percent); federal government (8 percent); and nongovernment (private) sources (7 percent). The money was spent as follows: elementary–secondary education (68 percent); universities (19 percent); vocational training (5 percent); and community colleges (8 percent).

4. Supply of Personnel (Including Teacher Education)

Supplying personnel for Canada's educational systems in the 1960s was a problem. There were more teaching jobs available than there were qualified Canadians to fill them, and so many school boards recruited staff from outside the country as their school systems entered a period of unprecedented growth, due largely to the postwar baby boom.

In the early 1970s, the bubble burst. The twin effects of declining enrolments and relatively less money for education sent school systems into a period of retraction. Graduates from teacher-training institutions found few jobs available, especially in the popular urban areas.

With the demand for new teachers lessening each year, fewer students are entering teacher-training institutions. In 1975–76, the full-time undergraduate enrolment in education was 45,118. In 1980–81, it was only 36,382, a drop of 19 percent. There were some 283,000 full-time elementary and secondary teachers in Canadian schools during 1977–78. In 1980-81, there were 273,700 and the projection for 1983–84 was about 268,000 (see Fig. 2).

Virtually all students now entering the teaching profession take their training at a faculty of education within a university. Only one province, Nova Scotia, still operates a teachers' college independent of the university structure.

There are still more women teachers than men, though the proportion is changing. In 1970–71, women constituted 62 percent of the teaching force but in 1980–81, only 56 percent. In nine provinces (data were not available for one province) and the two territories, 69 percent of public elementary-school teachers held a university degree in 1980–81, compared to only 35 percent in 1972–73. At the secondary level, 89 percent held degrees in 1980–81, an increase of 8 percent since 1972–73. As mentioned earlier, Canada has an ageing teaching profession. In 1972–73, 17 percent of teachers were under 25 years of age and 44 percent under 30. By 1979–80, these figures had fallen to 4 and 23 percent respectively. In 1980–81, the average age of an elementary teacher was 37, and of a secondary teacher, 39.

In spite of the tight job situation, large numbers of students, though not as many as a few years ago, continue to set their sights on teaching as a career. In 1969–70, education accounted for the largest group of male university graduates (16 percent), followed by engineering (11 percent) and business (7 percent). Education had slipped a little by 1980 but only to third place (12 percent), exceeded by business (14 percent) and engineering and applied sciences (15 percent). For women, education remains the top choice, accounting for 27 percent of female graduates in 1980, well ahead of the next two most common fields for women, languages (8 percent) and psychology (7 percent).

In his book on teacher redundancy, titled *Too Few Apples*, Chamberlain (1980) is somewhat critical of faculties of education. He writes:

> Despite an excess supply of teachers in some disciplines, universities continue to train and graduate students in overstaffed subjects, and some graduates continue to complain of receiving no career counselling while attending faculties of education. Some universities are changing course content in response to a changing market for teachers, but the modifications are not thorough. In some cases, the number of specialities offered students has increased, and advice is given on which speciality is marketable and which is not. But there is little known "ear-marking" of faculty of education enrolments; the choice of majors and minors still remains with the student. And universities have admitted that students continue to choose course majors and minors that bear no relation to the market realities described to them by faculty staff. Democratic though this policy may be, it is of little benefit either to teachers already employed, to school boards in search of instructors of speciality subjects such as music, arts, and hard sciences, or the graduates. (Chamberlain 1980 p. 85)

Constant efforts are made to improve the quality of education throughout Canada. There are many forms of inservice professional training for certificated teachers offered through summer courses organized by provincial ministries/departments of education, school boards, or faculties of education. Courses and workshops are also available through teachers' associations and associations of educational and administrative officials.

Teachers who wish to move through the ranks of department head, vice principal, principal, and senior administrator in a school-board office find it is many years before they can enjoy a full summer holiday, the usual time for taking professionally upgrading courses.

Declining enrolment and a poor economy have resulted in few, if any, new senior administrative positions coming into being. On the other hand, various incentives for early retirement are having the desired effect, and so generally speaking there is still room at the top for the talented and ambitious teacher who is willing to raise his or her qualifications through the numerous summer, evening, and weekend courses available. As well, a number of school boards now hire senior staff on a term-contract basis which creates a more frequent turnover of senior personnel than would otherwise be the case.

5. Curriculum Development and Teaching Methodology

For a brief, general description of curriculum development across Canada, Gayfer (1978) is probably the best source:

The ministry of education is responsible for describing and prescribing courses of study which set out the content of the school program and the overall sequence in which it is taught. The minister authorizes subjects which are to be compulsory. (In Ontario and British Columbia a "core" curriculum was introduced in 1977. For example, Ontario's core of compulsory subjects in the first two years of secondary education is composed of English, mathematics, science and Canadian history or geography.) A wide variety of optional or elective courses (from languages to environmental studies) are also offered. Many departments of education issue curriculum guidelines which are authorized statements of a general nature outlining the course content. It is the responsibility of the supervisory officers of a school board to see that particular courses of study are designed within the rationale of the philosophy and approach outlined in the guidelines. Principals also share in this duty.

In most provinces, it is the intent of current policy that teachers, preferably in the setting of the school staff, take an active role in designing the courses they teach. The participation of students, especially at senior levels, is also encouraged. For new courses, school boards must seek approval from the minister. A new course is usually introduced at one or a few schools before a ministerial decision is made on its province-wide application. (Gayfer 1978 p. 18)

There is no uniform, nationwide curriculum in Canada, and even within provinces there are many differences among school systems as to how departmental guidelines are interpreted and implemented. With some understanding of this vast country, it can be readily understood why there is no national curriculum.

Probably all good teachers have always recognized the fact that each child has his or her own interests, problems, and pace in learning, and that not all students react well to one particular teaching method. The discovery method became popular in science classes in the 1960s. This method requires students to conduct experiments themselves to find answers to problems, rather than be told or shown by demonstration. Team teaching, especially at the elementary level and in open-area schools, is still practised; generally, good results are claimed by the users. Audiovisual aids are in widespread use and have been for some time. As the new technology develops and becomes less expensive, no doubt computer-assisted learning will become a common part of teaching methodology. Canada's pioneering efforts in distance learning with the use of satellites and microcomputers has already attracted international attention.

Although still practised by some teachers in elementary and secondary schools, the "lecture" method is probably employed by fewer teachers now than ever before.

In Canada, parents who move from one province to another would say that the chief problem with curricula is that it is not the same in every province. Educators would respond by saying that at least some of the curricula used in a Newfoundland outport school would not be relevant to a student in Winnipeg, Manitoba, and vice versa.

6. *Examinations, Promotion, and Certification*

Until the 1960s, in most cases the only way a student could graduate from high school was by passing a set of "departmental exams". These examinations, compulsory and identical provincewide for every candidate graduate, became the object of much criticism during the 1960s. Opponents of provincial examinations argued that some capable students who had performed well all through elementary and secondary school would "freeze" during final provincial examinations and fail, whereas other, less capable students, would cram, pass, and immediately forget everything they had memorized during the few days before the exams. The argument was also put forward that teachers of graduating classes had to teach for provincial examinations, concentrating on topics that might not be relevant to students in their particular region, but that nevertheless were likely to appear in the final examination.

Provincial ministries/departments of education gradually withdrew completely, or lessened considerably, the influence provincial examinations had on students' graduation chances. In most cases now, it is classroom teachers and principals who determine whether or not a student will graduate from secondary school. Their judgments are based on overall school performance, including local school examinations and tests.

It is unlikely there will ever be a complete return to provincial graduation examinations as they were 20 years ago, but several provinces now have provincial achievement tests that are intended to set durable provincial achievement standards.

7. *Educational Research*

An excerpt from a 1981 report, "Canadian Research in Education: A State of the Art Review" (Andrews and Rogers 1981) provides a brief description of the evolution of educational research in Canada:

> In Canada it has been traditional for secondary school teachers to be trained at universities. Thus there have been university faculty members representing the field of education from the earliest times. Indeed, it is reported that the first doctorate awarded by the University of Toronto in any field was in education. The number of professors of education was small, however, and most were formerly eminent educators from the school systems who were appointed for their practical experience and wisdom rather than for their scholarship. Each professor was a generalist. Although different courses were offered, many would usually be taught by the same professor. Indeed, in the smaller universities a single professor would teach all subjects.