Improving mathematics education in Cameroon secondary schools: the case of the anglophone system of education

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ABSTRACT

Mathematics is compulsory in secondary schools in Cameroon, yet it is one of the most unpopular subjects as seen from students' performances and absentee rates at the G.C.E. O/L. examination. This may be attributed partly to the way it is taught and partly to societal views about mathematics and its influence on students. Most mathematics teachers have little or no exposure to mathematics teaching methodology (mathematics didactics). At the teacher training colleges emphasis seems to be placed on the general principles of teaching. Specific subject didactics, which should complement this, is given less emphasis. Graduates of teacher training institutions are hardly exposed to innovations in mathematics teaching methodology because of inadequate opportunities for in-service seminars. Most of the teachers tend to teach the way they were taught. Teaching depends on the individual's knowledge of the subject matter, conceptions about teaching, training and experiences. Rather than teach mathematics as a living subject that challenges the intellect and imagination, it is taught as a "dusty collection" of historical facts. This paper aims at looking at possible ways to improve the teaching of mathematics in the anglophone educational system in Cameroon secondary schools. This is done partly through identifying and analyzing some of the weaknesses of some current practices, and partly suggesting how mathematics didactics could help teachers in training as well as those in the field. The latter is done through pointing out what should be included in content of didactics in teacher training institutions and making suggestions on some general ways of teaching mathematics.

Key words: mathematics, didactics', school, teaching, Cameroon

RÉSUMÉ

Les mathématiques sont obligatoires dans nos establishments mais elles sont une des disciplines les plus impopulaires. On pourrait attribuer les causes d'un côté à la manière dont elles sont enseignées et de l'autre à sa conception par la communauté. La plupart de professeur des mathématiques sont peu ou ne sont pas du tout exposés aux didactiques des mathématiques. La didactique de disciplines spécifiques devrait servir de complément aux principes généraux. Les élèves professeurs des institutions de formation en fin de formation ne sont pas exposés aux innovations à la méthodologie des mathématiques. Ils ont tendance à enseigner avec la même méthode avec laquelle on leur avait enseigné sans aucunes innovations. Enseigner dépend du savoir de l'individu du matière à enseigner, sa conception du métier, sa formation et ses expériences. Au lieu d'enseigner les mathématiques comme matière qui évolue et qui stimule l'esprit et imagination, le matière est enseigné comme un aggregation statique des faits historiques acquis. Cet exposé a pour objectif de voir les différentes stratégies pour améliorer l'enseignement des mathématiques dans nos institutions secondaires. Ceci d'un côté en identifiant et analysant les faiblesses des certaines pratiques en cours, et de l'autre en suggérant ce qu'on pourra faire en ce qui concerne la didactiques et les enseignants sur les terrain.

Mots clés: mathématiques, didactique, insitutions, enseignement, Cameroon

Introduction

The issue of improvement in the teaching of mathematics has long been a major concern in schools with considerable debate about mathematics content and the effectiveness of teaching approaches, sequence of topics, and priority in the curriculum (Backhouse et al., 1992; Bell et al., 1983; Bishop, 1992; Chapman, 1972; Cooper, 1985; Freudenthal, 1991; Koehler and Grouws, 1992; Hirsch and Zweng, 1985). This has often resulted in recommendations for particular teaching approaches or considerable efforts to create new curriculum materials (Bell, 1979; Scott, 1972; Lerman, 1989) or both. For example, Ahmed (1987, p.3) cites the following cases:

> i)...scholars will be trained at an early age to use their intelligence, and not to place undue reliance upon the mechanical application of general methods; (Suggestions for the consideration of Teachers, Board of Education, 1905);
>
> ii)... teaching should, in the main, be based upon the child's experience and previous knowledge and ... upon definite experiments made by him with concrete objects. (The Teaching of Arithmetic in London Elementary Schools, LCC, 1911);
>
> iii)...teachers should restrict themselves to giving children facility only in such mathematical skills as they can use and see the point of using. (Handbook of Suggestions for teachers, HMSO, 1937);

Freudenthal (1991) noted that E. W. Beth in a colloquim in 1952 claimed that

> Le rôle de la formation mathématique dans l'enseignement secondaire consiste, presque exclusivement, me paraît-il, à familiariser les élèves avec la méthode déductive.
>
> (I think that mathematics education in secondary schools ought to emphasise deductive reasoning.)

In the second half of the century, the mathematics reform in the 1950s - 1960s ushered in the "New Mathematics"; what Ernest (1989, p.9) describes as "the decade of progressive teaching methods, including discovery learning, and the beginning of interest in problem-solving and mathematical investigations". During the 1960s, "discovery learning", "concept acquisition" and "learning by doing" became part of the fashionable mathematics teacher's vocabulary (Cornelius, 1982). Basic skills and techniques were often relegated to a lowly position as relevance and

involvement became the goals. The Cockcroft Report, *Mathematics Counts*, (1982), regarded as a landmark in the development of school mathematics in Britain, (paragraphs 240 - 251), recommends that teaching at all levels should include opportunities for

> exposition by the teacher; discussion between the teacher and the pupils, and between the pupils themselves; appropriate practical work; consolidation and practice of fundamental skills and routines; problem-solving, including the application of mathematics to everyday situations; and investigative work. (para. 243).

Mathematics is one of the compulsory subjects at both the primary and secondary school levels and it is one of the examination papers for most competitive examinations. Most mathematics teachers talk to students about the usefulness of mathematics in other subjects, their daily lives and in future employment but this is mostly lip service because their teaching hardly reflects real life situations. Despite all these, most students in anglophone secondary schools show a dislike for this subject. An examination of the performance in six basic subjects offered by most school candidates at the Cameroon GCE Ordinary Level examination shows that the poorest performance is in mathematics (Appendix I). The question is why students perform so poorly in mathematics. Desforges and Cockburn (1987) remarked that the problem of mathematics education is a many-headed monster involving an appreciation of the psychology of learning, societal demands, the structure of mathematics, the design of curriculum materials and mathematics pedagogy. The interim report by Mathematics Working Group for the national curriculum for England and Wales (Nov. 1987:4) noted that although there is a variety of reasons for students' dislike for mathematics the two most important reasons are *"the narrow or unsystematic ways in which they have been taught it, and the poor image they have formed of mathematics as an impersonal boring subject, lacking relevance".* Failure and consequent lack of confidence in their own ability were other reasons.

The problem of poor performance in and attitude towards mathematics is obviously complex and has its origin in several interacting factors. Assuming that the problem is from the teaching approaches (methods or practices) used by teachers rather than the content of the subject per se, it is necessary for teachers to be aware of the contribution by current methods used in order to improve on these.

This paper aims at examining the impact of teaching approaches used in secondary schools in the anglophone educational system in Cameroon on the learning of mathematics with the intent of

(i) helping teachers improve their practices and
(ii) making suggestions on how to improve the teaching - learning of mathematics.

1. Some identified problems with mathematics education in the anglophone educational system

The present mathematics programme in anglophone Cameroon secondary schools and the manner in which it is taught is characterized by approaches that encourage a close association between pure and applied mathematics, or a "general predilection for teaching mathematics in a way that emphasises some of its application", (Lighthill, 1978). Mathematics is seen as a set of rules, techniques and procedures, and mathematics teaching appears to emphasise these values. Also the utilitarian aspect of mathematics is encouraged. Secondary school mathematics education in anglophone Cameroon has been a topic of much public concern. Mbuntum (1981) lamented the massive failure of anglophone students in mathematics at the then sole University of Yaoundé. Mbuntum saw the problem as coming from the content and on deficiencies in anglophone mathematics education, whereas Eba (1981), then Provincial Inspector for mathematics and mathematics lecturer at E.N.S.A.B., blamed it on a "teaching approach" which he claimed was based on the francophone philosophy of mathematics teaching predominant in the University of Yaoundé. But massive failure in mathematics is also experienced at the secondary schools both in class examinations and at the General Certificate of Education Examination, Ordinary Level. In the latter, the percentage pass has hardly gone above 30 per cent and the rate of absenteeism of candidates from the examination is alarming. A study by McNamara (1989) showed that the performance of students in this examination showed signs of improvement following the setting up of the INSET (in-service project providing some pedagogic assistance) by the British Overseas Development Administration (ODA) in 1985; an indication that the teaching approach contributes to students' performances.

In the anglophone educational system, some of the factors that have been identified are:
- students' background from the primary school level;
- societal (peer and parental) influence;
- the mathematics content at this level;
- lack of effective learning;
- transfer of training;
- methods of assessment;
- teachers', students' and society's beliefs about mathematics;
- the nature of the syllabus and examination at the O level;
- the nature of mathematics teaching, and its antecedents, as well as other interrelated problems, such as language difficulties;
- the mismatch between the syllabus/examination and the actual teaching that takes place;
- students' experiences of failure and consequent lack of confidence in their own abilities
- the primary/secondary school mathematics interface.

(Njei, 1988; Nges, 1989; Fombin 1990; Ndifon 1991; Fomumbod 1993; Babila-Njingum 1995; Babila-Njingum née Ghogomu 1998;). There is every indication that the teaching approach is a major factor in poor performance. Let us examine some teaching approaches currently being used in Cameroon secondary schools. Only some of these aspects will be discussed in this article.

2. Current teaching approaches

A student describing how he was taught mathematics at the secondary school said:

"The teacher writes mathematical concepts and rules on the board and explains these. Then solves one or two problems. Then puts up some problems for us to solve and walks round the class marking our books."

Within this statement and from classroom observation, some of the major characteristics of the current teaching approaches are exposition, discussion, teaching for examination purposes and inadequate equipment.

2.1 Exposition and drill exercises

The principal method of instruction in anglophone secondary schools is still largely the expository class lesson with the main teaching and learning aids being the blackboard and chalk (McNamara, 1989). The teacher plans material, presents this in a short expository phase in the early part of the lesson and sets the class to work on an exercise with the hope of reinforcing, and possibly testing, the students' understanding of what has been done. While the children carry out routine pencil-and-paper practice, the teacher either circulates amongst them to provide encouragement, help with individual difficul-

ties, make ticks for correct solutions, or in some cases just distracts him/her while waiting for the students to finish. (Large class sizes debar most teachers from doing this.) At the end the work is either corrected by the teacher, or one of the students on the board. Most of the exercises (usually picked from the textbooks) do not reflect any real world problems and demand nothing other than repetition of taught skills; thus the acquisition of information, as such, becomes an end in itself (Desforges and Cockburn, 1987).

2.2 Discussion

Some form of discussion may take place in the early part of the lessons, when the teacher tries to draw out ideas from his/her students by a question and answer approach. Discussion for the sake of improving concept acquisition, or problem solving approaches, is hardly ever carried out.

2.3 Practical work

Although at the nursery (kindergarten) school level and early years of primary education, certain mathematical concepts are taught through practical activities, this approach is almost completely neglected at secondary school level. Any form of practical or investigative work is limited to measuring of angles, throwing of a die to introduce the concept of probability or using cylindrical cans to establish an approximation to the constant "pi" (π). Such methods are usually practised by some of the more experienced teachers. It is expected that trained and untrained, experienced and inexperienced mathematics teachers in anglophone secondary schools should not be strangers to the idea of individual differences; but large class sizes averaging 80 students (Njeuma, 1986:136) creates a situation where only lip service is paid to this idea. According to some of the teachers, group work cannot be carried out with this number of students in one class.

2.4 Drill and practice

This teaching approach is mostly used when "teaching for examination". Teaching, especially in Forms Four and Five, Lower and Upper Sixth Forms, is generally geared towards having students pass examination. Most teachers see the use of past examination questions as a source of motivation. Some teachers spend time in solving past examination questions related to a topic just taught. In most cases, teachers have either solved some of the problems many times over or rehearsed them at home making mistakes and correcting these before coming to class. (Students are not given the opportunity to see the teacher's trend of thought. They

see the teacher as a genius and nurse the feeling that they must reach the teacher's level to be able to do the same or similar problems with the same ease.)

2.5 Equipment

One of the most pertinent problems facing the choice of teaching method is equipment. Textbooks sometimes determine teaching approaches. Because of the inadequate training of most of the teachers, any text that may be recommended is used as the main resource material. Generally, only one textbook, usually determined by the teacher is used, and this serves as the main resource with the teachers "following the sequence and using its suggestions for dealing with the content" as described by Goffree (1985:26). Most of the books used in anglophone secondary schools are of foreign origin (Ordinary Level Mathematics by Harwood Clarke for the O/L and for the Advanced Level the series by Bostock and Chandler). These books were developed following the curriculum changes in the early sixties that were imported to the less developed countries. In adopting textbooks with European origin, the question of whether the inherent teaching methods, on whose basis these books were written, were equally appropriate to the society was never asked (Wilson, 1992). McNamara (1990:8) noted that

> ... the slower revolution in methodology of the 1970s was not exported to 3rd world countries with anything like the same zeal and impact as the new syllabuses of modern mathematics.

The other documents consulted may be the Scheme of Work and examination syllabus, either to find out which topic should be taught next or to see if a good part of the syllabus has been covered.

3. Observations and suggestions for improvement

3.1 Observations

From a close examination of the current teaching approaches used in anglophone secondary schools in Cameroon, it may be remarked that too often, school mathematics teaching has concentrated on the manipulation of symbols to the exclusion of the total context. Students hardly have the opportunity to think through alternative approaches to problems or consider the merits and disadvantages of applying different perspectives. Students are at times taught skills independent of application to real world situations. Such teaching concentrates on providing basic skills described by Cain et al. (1985) as 'traditional' and do not provide abstraction skills needed at higher levels.

For example, it is common to find secondary school students, when asked to find the inverse of a 2 x 2 matrix

such as $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$, simply write down

$\dfrac{1}{ab-cd}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$ without carryout the procedure that

shows their understanding of what the inverse is, so that they can find the inverse of a 3 x 3 matrix. Thus, mathematics is taught as a set of rules and this does not encourage critical thinking.

Division by a whole number, a fraction and by zero

a) Consider 8 divided by 2. This can be interpreted as:
   (i)   8 objects shared into two equal parts with the result being 4 objects in one part, or
   (ii) 8 objects shared in such a way that there are 2 objects in each part which also results in 4 parts.

Although the result in both cases is "4", they are different in that in (i) the 4 is the number of objects in one part whereas in (ii) the 4 is the number of parts each containing 2 objects. Emphasis at the primary school level is laid on the approach in (i). It is expected that at the secondary school the approach in (ii) should be introduced.

b) Now consider "8 divided by ½". Anyone who does not understand the problem may give the answer as 4, obtained by the interpreting the statement as "divide 8 into two equal parts". The right interpretation is "how many objects can be made using 8 objects such that each is half of the original object". The acceptable result is 16. Teachers who see and teach mathematics as a set of rules will tell the learners that "to divide by a fraction, invert the fraction and multiply". That is "8 divided ½" is equal to "8 x $\frac{2}{1}$ ". This mechanical rule does not call for any thinking and may be accepted at the primary level. At the secondary school the teacher is expected to carry out the manipulation as

$\dfrac{8}{\frac{1}{2}} = \dfrac{8 \text{ multiplied by } \frac{2}{1}}{\frac{1}{2} \text{ multiplied by } \frac{2}{1}}$ where $\frac{2}{1}$ is the multiplicative inverse of ½.

With this the learner, when asked to divide by a frac-

tion, will have to find the multiplicative inverse of the fractional divisor. With the former approach a learner can easily carry out 25 divided by ¼ correctly but may not have any idea of what he/she is doing let alone being able to explain it. Yet the teacher may claim that the learner "**knows**" how to divide by a fraction because of the view that "doing demonstrates knowing". This may not be true in all cases. To know something is to be able to talk to someone about it. The latter approach needs to be re-enforced at the secondary schools.

c) Division by zero is often neglected at the secondary school level. It is not uncommon to have students (and some teachers) give the answer to "x divided by zero" as infinity. Although the properties of the set of numbers are discussed, "the non-acceptability of division by zero" for rational numbers is never discussed. This shows a lack of adequate depth in the teaching of some concepts.

Teachers tend to adopt this mechanical rule approach partly because of the technique-oriented curriculum that encourages impersonal learning by not paying particular attention to the affective and aesthetic features of the subject (Bishop, 1988) and partly because they ignore the aspect of critical thinking as part of mathematics. Although some students have exhibited very high achievement in mathematics and some have certainly found aesthetic and emotional satisfaction in the manipulative process, too many have found it arid and boring because its origin and purpose have not been made clear to them, or even been reflected upon by the teachers.

Students are hardly given the opportunity to have any input in the material they are learning. An exposition phase could be improved if teachers were to encourage students' input through questions, especially through the use of thought provoking questions rather than simple recall of facts. Learners should be encouraged to develop the habit of being creative. This can only be achieved if teachers can demonstrate their thought processes in solving problems to students rather than a "show-off" of how they can solve the problems. Some teachers spend hours solving a problem that they take to class and solve for the students as examples in five or less minutes. By so doing students are not exposed to their thought processes or having students see the mistakes they make when solving the problem whenever this occurs. This gives the false impression that all problems are within the reach of the teacher.

Standard or conventional algorithms should not be the only manner in which mathematical knowledge can be displayed. Acknowledging learners' methods, provided they are logically acceptable, is a powerful motivating factor. Peer assistance should be encouraged for the benefit and motivation of the learners. As pointed out by Babila-Njingum née Ghogomu (1998:79), in teaching the teacher needs to

> - organize frequent co-operative group discussion within which students should discuss problems and alternative solutions;
> - adopt an explanatory rather than transmission approach so that students can build the spirit of enquiry that can help them in learning how to learn mathematics;
> - encourage intrinsic motivation in mathematics so that students do not just learn it because it is compulsory but because they have the desire to learn it.

Because of the mixed ability nature of classrooms in Cameroon the teacher needs to use a variety of teaching approaches to be able to accommodate learners with different learning styles. To this end teaching and learning aids are an unavoidable tool for the learning process. These are issues that should be emphasized at initial training through didactic courses.

3.2 Suggestions for improvement

3.2.1 The role of mathematics didactics in teacher training courses

Considering the aptitude of students who come into teacher training institutions, mathematics didactics need to be given a great emphasis. Mathematics teaching approaches is an aspect of teacher training that should be handled by mathematics didactics. Every teacher needs a theory of learning. As teachers we adopt certain ploys or use particular methods because we believe they work. This is based on experience, intuition and perhaps on wishful thinking. As Orton (1992:1) notes, such theories "may be helpful, they may, on the other hand, be dangerous". It might be argued that the knowledge of mathematics coupled with the fact that the would-be teacher is going to teach at a level he/she had passed would be sufficient to prepare the teacher to teach at that level. Skemp (1986:34) remarked that

> To know mathematics is one thing and to be able to teach it — to bring others at a lower conceptual level to know it — is quite another; it is the latter that is lacking at the moment.

Mathematics didactics should be seen as that aspect of the teacher's education that provides knowledge of mathematics pedagogy. Ernest (1989:249) suggests that

> The practice of teaching depends on a number of key elements, most notably, the teacher's mental contents of the schemes, particularly the systems of beliefs concerning mathematics and its teaching and learning; the social context of the teaching situation, particularly the constraints and opportunities it provides; and the teacher's level of thought process and reflection.

The mathematics teacher needs **knowledge of mathematics, of pedagogical content and of the curriculum or of teaching mathematics, of organization and management for mathematics teaching, of context of teaching, of education, and of other subject matter.** Although Science of Education course should provide the knowledge of education (part of which would be emphasized in the organization and management of mathematics teaching), didactics should treat these with particular emphasis on the pedagogical content knowledge and knowledge of the curriculum or knowledge of teaching mathematics. Pedagogical knowledge of mathematics is knowledge that teachers use to transform and represent their own subject-matter knowledge of mathematics for teaching. This includes knowledge of approaches to topics within mathematics, different ways of presenting the mathematics, and knowledge of materials through which the instruction can be carried. As Haggarty (1995:10) notes, this material might include knowledge and awareness of the use of various textbooks and schemes, syllabuses and other teaching resources.

Mathematical misconceptions and attitudes that students have at the secondary school are very resistant and resilient to change even among university graduates. Didactics should enable the student teacher to reflect on these and devise strategies to eliminate them. Initial training programme should help student teachers develop characteristics and desire for development (Babila-Njingum née Ghogomu, 1998). In assessing student teachers' teaching, they should show attributes such as evidence of the ability to develop professionally, the ability to develop personal strategies to overcome problems and willingness to fill any gap in knowledge and skills recognized. In addition, the content of didactics should include aspects of beliefs about mathematics and the nature of mathematics, and how these

affect mathematics teaching. Granting that there are few local authors of mathematics text books, didactics should treat textbook evaluation to help the teacher select relevant material that meets the demands of his/her environment without ignoring the specificity of the subject. With this teachers will be able to choose locally produced and low cost teaching learning aids. Many teachers on the field are capable of doing this given the opportunities. Evidence from a research carried out in five secondary schools in the anglophone educational system in Cameroon (Babila-Njingum 1995) and a series of pedagogic seminars held in the North West Province of Cameroon (Babila-Njingum and Dean 1997) showed that secondary school teachers see the need to change their teaching approaches but continue in their old ways because of certain constraints, some of these being the large class sizes and overloaded mathematics syllabus. Teachers who took part in the research found group work and peer assistance to be useful in the teaching-learning process but needed assistance to manage this with large class sizes. Didactics should provide teachers with necessary strategies. To this end there is need to encourage collaboration between the science of education course and specific subject didactics. From attempts at such a collaboration introduced in E. N. S. A. Bambili (ENSAB), the Provincial Pedagogic Inspector for Mathematics North West Province Cameroon remarked that ENSAB mathematics student teachers' teaching practices have shown a marked positive change.

3.2.2 Suggested teaching approaches

Freudenthal (1972, p.12) recommends that mathematics should be presented as a subject to be discovered and learned in the same order and manner it was created. Axiomatization and normalization of some aspects of mathematics should be performed by the students and not presented to them. Thus, one of the most important of the teacher's role in the classroom is helping students to acquire the necessary skills (Polya, 1957). Students should be given the opportunity to acquire much experience of independent work but not left alone or given insufficient help because, then, they will not progress. For effective help, the teacher should assume the place of the learner and try to understand what is going on in the learner's mind and indicate steps that could have occurred to the learner him/herself. This is not an easy task; it demands time, practice, and devotion. Zawadowski (1990, p.235) suggests that

> ... in mathematics teaching less emphasis should be place on formal rigor, but stress instead visual

representations, the use of pictures in communication about mathematics, and the meaning of formulas (in addition to their formal properties).

The end of the eighties saw greater emphasis on the constructivists' view of mathematics teaching, which lays emphasis on how mathematical knowledge is presented and explained. The view emphasizes that the presentation and explanation should be such as to facilitate the child's learning (child's learning being focusing on what the child perceives in any situation, including what the teacher presents: Lerman, 1989, p.76). Davis et al. (1990, p.2) remark that

> many people, other than mathematicians, engage in mathematical activity, ... while engaged in mathematical activity, all of them have to hypothesize, try things out, execute mathematical procedures, communicate and defend results, and reflect on the methods selected and results generated. From a constructivist perspective these activities are all part of what it means to engage in mathematics. Learning mathematics requires construction, not passive reception, and to know mathematics requires constructive work with mathematical objects in a mathematical community. Mathematics teachers, therefore, need to accept as a major task the responsibility for establishing a mathematical environment in their classrooms.

According to Fischbein (1990), to learn mathematics is to construct mathematics and mathematical activity is essentially a constructive process. So, the students should learn mathematics not by absorbing concepts, definitions, theorems, and proofs, but by constructing them through their own intellectual efforts. Teaching mathematics as a creative and discovery subject will enable students to construct their own mathematical knowledge seeing that "all mathematics discovery integrates former skills into new networks of reasoning" (Kuyk, 1982, p.16). There should be a shift from 'transmission' pedagogy to investigations and 'activities' pedagogy. The learning of mathematics, especially in its early stages, for the average student is dependent on good teaching. The style and atmosphere of the activity in the mathematics classroom is a strong component of what is learned by the students. From this they see mathematics either as a field of inquiry, or a deductive system, or a set of methods to be learnt from the teacher or, a combination of these.

The way teachers teach mathematics is influenced by

the teacher's knowledge of how students might learn or understand particular content and his or her beliefs about teaching, the nature of mathematics and mathematics education (Bishop, 1988; Blaire, 1980; Burton, 1988; Koehler and Grouws, 1992; Ernest, 1987, 1989; Freudenthal 1991; Lerman, 1983; Orton, 1987, 1994; Shulman, 1986). Koehler and Grouws (1992, p.118) remarked that

> teachers who believe that students learn by explicit example and repetition or by extensive practice, and who see their roles as dispensers of information, would behave differently in the classroom than teachers who believe students learn by discovery or investigation and who see their role as 'co-explorers' with the student.

Views about the nature of mathematics play an important role in the teaching of mathematics. Freudenthal (1991, p.131) remarks that

> Whoever cherishes a picture of mathematics outside the world — a deductive system or a catalogue of formulae — is likely to systematise or to interpret mathematics instruction in the same spirit. On the other hand, whoever experiences mathematics [as] something in the making, vibrating under the impulses of world and society, will be inclined to teach it in the same way — directly or as an educational developer.

He also pointed out that the question, What is mathematics? "Is a thorny question" because there seems to be no unique answer to it (ibid. 1991, p.1); a point echoed by many others: (Kitcher, 1984; Chapman, 1972; Ernest, 1987, 1991; Wilder, 1972). Freudenthal (1991, p.1) suggests that "mathematics" must be a combination of things because it seems to be in the plural form: in English - Mathematics, and in French - Mathématiques. This ties in with Kilmister's (1972, p. 23) view that

> inquiries as to the nature of mathematics often become confused because the word mathematics can be used in two distinct and different senses, i.e. the methods used to discover certain truths and the truths which are discovered.

Freudenthal (1991) notes that it is easier to say what we can do with a piece of mathematics than to say what mathematics is. One view is that the truths which are discovered are used and that this emphasises their utility, and a second is that it is a creative activity and a process.

Teaching Mathematics as a utilitarian subject

In the course of the organisation of the raw material of mathematics, general concepts are formed which are expressed in symbolic form. This symbolisation is crucial in the development of mathematics. The language of mathematics is symbols; thus, mathematics can naively be seen as a set of words and symbols (abstractions from realities) because in mathematics these symbols are used to represent abstract entities (Marjoram, 1974; Sfard, 1991). Symbols are used to express in a few lines what would otherwise be written in a number of pages. This aspect of mathematics permits it to be used by other disciplines to express relationships between various concepts, hence the view that mathematics is a tool. Well-chosen symbols not only make possible the manipulation of the material of mathematics but show patterns that have their own logic. Mathematics, then, can be seen as an activity concerned primarily with argument, with spotting patterns and posing premises, and investigating their implications and consequences. For example the pattern:

$$1 \times 3 + 1 = 2^2.$$
$$2 \times 4 + 1 = 3^2$$
$$3 \times 5 + 1 = 4^2$$

that leads to the assertion that $n(n + 2) + 1 = (n + 1)^2$.

Hence, mathematics takes the position of a language in its utilitarian form because it has logical (formal) structures that can be used to express scientific and other notions (Freudenthal 1991; Orton, 1994).

Knowledge is not information even though it is built from information; it is an integrated structure of relationships among concepts and propositions. Von Glasersfeld (1989, p.12) remarked that knowledge cannot be reduced to a stack of retrievable "facts" but concerns the ability to compute new ones. This new knowledge may either add to or modify some existing piece of mathematics. This view lays the basis for modelling in mathematics teaching, given that symbols provide an economy of thought through which many of the elements of mathematics could be stacked away in a well organised form so that verification is possible.

Teaching mathematics as a creative activity and a process.

The history of mathematics clearly indicates that the knowledge of one generation of mathematicians is obtained either by extending the knowledge of the previous generation or, by the purposeful organisation

of quantifiable observations, to help control, explore, improve or describe the environment, and it is closely linked to social needs of time and to the demands of society (Kitcher, 1984; Schools Council, 1980). It might therefore be claimed that mathematics is largely the product of determination of the human race to understand and control the environment with concepts furnished from the physical world. Consequently, it can be seen as the creation of human mind that may be limited only by the cultural environment. Teaching should reflect this aspect. Marjoram (1974, p.135) says that

> ... the child well-guided and properly motivated, may be led to tease out many mathematical threads from the cocoon of his own experience in his struggle to orient himself in space and society.

As a result, children can often come up with different mathematics from the practice provided in the classroom, as illustrated by the following examples.

(i)   To evaluate 73 - 48, a student proceeds as follows:

> "Keeping off the 3 from 73, and the 8 in 48, notices that 70 - 40 = 30
> $$30 - 8 = 22$$
> and $$22 + 3 = 25$$
>   answer is 25. "

(ii)   To solve for x in the equation

" $$14 - \left(\frac{15}{7-x}\right) = 9$$

the student argues as follows:

14 minus what equals 9? Answer 5
15 divided by what equals 5? Answer 3
therefore 7 - x is 3;
and 7 minus what equals 3? 4   Answer: 4.
                (Bell et al. (1983, p. 142)

Underhill and Jaworski (1991, p.9) refer to these as "child methods" which can be described as invented procedures or algorithms for solving mathematical problems. They also remark that children ought to be encouraged to be creative in mathematics lessons; and any methods they come up with not thrown away as wrong but used to point out their mistakes. Von Glasersfeld (1989, p.14) notes that

> children, we must never forget, are not repositories for adult 'knowledge' but organisms that, like all of us, are constantly trying to make sense of, and to understand their experiences.

Thompson (1985) emphasises that what we call mathematical knowledge is a structure of thinking and that "mathematical knowledge arises from abstracting the invariant features of one's thinking in problematic situations" (quoted in Underhill and Jaworski, 1991, p.8). Mathematics should be seen as the activity and the processes involved in carrying out the activity, and a way of thinking (Sfard 1991). For example, saying that " there exists a function, such that ..." in mathematics is like talking about the existence of certain subatomic particles in physics, but unlike material objects they can be seen only with our minds' eyes. Hence, the symbols

$$"f : \rightarrow ...",$$

as written on the paper, are but one among many representations of some abstract entity which by itself can be neither seen nor touched. Being capable of somehow "seeing" these invisible objects appears to be an essential component of mathematical ability. A similar notion can also be defined as a certain computational process as

$$f(x) = 3x^2, \text{ say,}$$

which may be considered as a process, algorithm and action rather than an object. Mathematics is both content and procedure, and the business of mathematics teaching is an induction into ways of "seeing" its objects and promoting a facility with the required actions on them.

Conclusion

Teaching poses a complicated communication problem, more so with a class of over forty learners with varying backgrounds. Learning mathematics, unlike some subjects, does not rely on the teacher demonstrating his/her ability to solve many problems. Therefore mathematics teachers do not only need to know the mathematical concepts to be taught but also how to teach them. Mathematics didactics should amongst many things examine some of these reasons and theories of teaching and learning specific to mathematics. Current teaching has encouraged rote learning, memorisation, practice and the application of skills and techniques sometimes with no understanding. Some school of thought expected the teacher to transmit mathematical knowledge meaningfully to the learner using various approaches, such as demonstrations and other activities, which will motivate and facilitate learning as well as understanding. Ernest (1991, p.177) describes this idea as 'teaching mathematics' as opposed to 'teaching children'. Teachers argue that the present approaches used are to enable them complete the programme and to meet up the demands of external examinations. Syllabus coverage without learning should not be our priority. Freudenthal, (1991, p. 167) points out that

> Learning simple mathematics at a reasonable level is a more dignified pursuit than learning com-

plex mathematics at no level of understanding at all.

Teaching should be carried out through the provision of a carefully structured environment and situations that can be exploited by the learner. The teacher should act both as a resource and a facilitator for the learning process. The teacher lays emphasis on non-intrusive guidance, and shielding from conflict, threat and sources of negative feelings directed towards the learner. Teaching should be carried out by providing a wide variety of practical resources for creative and critical activities to be used by individuals or groups of learners.

This paper aimed to identify the weaknesses of current teaching methods used in the anglophone system of education in Cameroon and to make suggestions on what could be done to help teachers improve on their teaching approaches. Current teaching practices by mathematics teachers contribute to students' poor performances partly because teachers are deficient in the current trends of mathematics teaching and partly because they do not exploit students' creative abilities or treat the learners as individuals. Rather than teach mathematics as a living subject that challenges the intellect and imagination, it is taught as a "dusty collection" of historical facts.

APPENDIX

Number of students who entered for the examination but stayed away (absenteeism)

	BIOLOGY	ENGLISH	FRENCH	MATHEMATICS	GEOGRAPHY	HISTORY C
1995	abs. 616	abs. 283	abs. 2678	abs. 5547	abs. 406	abs. 308
	ent. 11807	ent. 21667	ent. 18660	ent. 18990	ent. 15253	ent. 8424
1996	abs. 392	abs. 256	abs. 1692	abs. 5189	abs. 291	abs. 253
	ent. 10729	ent. 21002	ent. 17935	ent. 18237	ent. 15148	ent. 8316
1997	abs. 326	abs. 291	abs. 2023	abs. 5054	abs. 302	abs. 158
	ent. 10634	ent. 20598	ent. 17781	ent. 17928	ent. 15212	ent. 3812

abs. = absent   ent. = entered

Percentage of those who passed the examination

	BIOLOGY	ENGLISH	FRENCH	MATHEMATICS	GEOGRAPHY	HISTORY C
1995	68.32	26.32	29.86	19.34	60.52	46.75
1996	58.10	39.40	29.16	23.85	42.87	35.64
1997	74.50	31.13	33.35	19.89	48.77	69.40

Candidates' performances are graded as A, B, C, D, E and U. A is the highest grade, A, B and C are pass grades, D and E are levels of attainment while "U" is considered as not good enough to be graded.

Number of candidates who obtained Grade "U"

	BIOLOGY	ENGLISH	FRENCH	MATHEMATICS	GEOGRAPHY	HISTORY C
1995	2179	7559	9095	9725	2885	2468
1996	2417	2687	8864	8902	4893	2596
1997	1213	4065	8218	9125	4328	

(*Source:* Detail analysis of results of the GCE Examination by the Cameroon CGE Board. 1995, 1996, 1997)

REFERENCES

AHMED, A. (project director) (1987) *Better Mathematics: A curriculum Development Study based on The Low Attainers in Mathematics Project.* H.M.S.O.: London.

BABILA-NJINGUM J. (1995) *Perceptions of First Cycle Secondary School Mathematics in Anglophone Cameroon and The Potential for Change* Ph.D. Thesis, The University of Reading, England.

BABILA-NJINGUM J. and Dean M. (eds.) (1997) *Proceedings of the INSET SEMINAR for Secondary School Mathematics Teachers North West Province 197/98* INSET PROJECT. Bamenda

BABILA-NJINGUM née GHOGOMU E. Y. (1998) *Secondary School Students' attitudes to Mathematics in Anglophone Cameroon* MSc dissertation. The University of Reading.

BACKHOUSE, J., HAGGARTY, L., PIRIE, S. and STATTON, J. (1992) *Improving the Learning of Mathematics.* Cassell: London.

BELL, A. W., COSTELLO, J. and KUCHEMANN, D. (eds.) (1983) *A Review of Research in Mathematical Education. (Part A): Research on Learning and Teaching.* Nfer-Nelson: Windsor: Berkshire.

BISHOP A. J. (1988) *Mathematical Enculturation: A cultural Perspective on Mathematics Education.* Kluwer Academic Publishers. Dordrecht.

BISHOP, A. J. (1992) International Perspectives on Research in Mathematics Education in Grouws, D. (ed.) (1992) *Handbook of Research On Mathematics Teaching and Learning. (A project of the National Council of Teachers of Mathematics),* pp. 710-723. Macmillan Publishing Company: New York.

CAIN et al. (1985) Mathematics in Secondary School: Four Points in View in Hersh C. R. and Zweng M. J. (eds) (1985) *The Secondary School Mathematics Curriculum pp 22-28.* The National Council of Teachers of Mathematics. Preston.

CHAPMAN, L. R. (1972) Attempts to investigate the learning of mathematics in Chapman, L. R. (ed.) (1972) *The process of learning Mathematics* (pp122-154) Pergamon Press: Oxford.

COCKCROFT, W. H. (chair) (1982) *Mathematics Counts: Report of the Committee of Inquiry into the Teaching of Mathematics in Schools under the Chairmanship of Dr. W. H. Cockcroft.* H. M. S. O.: London.

COOPER, B. (1985) *Renegotiating Secondary School Mathematics: A study of curriculum change & stability.* The Falmer Press: London.

Cornelius M. (1982) Teaching Mathematics in Secondary Schools in Cornelius M. (ed.)(1982) *Teaching Mathematics* pp. 112-129. Croom Helm. London.

DAVIS, R. B., MAHER, C. A. and NODDINGS, N. (1990) Constructivist Views on the Teaching and Learning of Mathematics, *Journal for Research in Mathematics Education Monograph, 1990, number 4,* pp. 1-3. National Council of Teachers of Mathematics: Virginia

DESFORGES C. and COCKBURN A. (1987) *Understanding the Mathematics Teacher: A study of practice in first schools.* The Falmer Press. London

EBA P. N. (1981) Looking Back at *Mathematics West of the Mongo. A cause for Concern Cameroon Tribune of July 22, 1981, no. 370 pp.8-10.* AGRACAM Yaoundé

ERNEST, P. (1987) *The Knowledge, Beliefs and Attitudes of the Mathematics Teacher: A Model.* University of Exeter.

ERNEST P. (1989) The impact of Beliefs in the Teaching of Mathematics in Ernest P. (ed.) *Mathematics Teaching: The State of the Art* pp. 249-254. The Falmer Press. London.

ERNEST, P.(1991) *The Philosophy of Mathematics Education.* The Falmer Press: London.

FISCHBEIN, E. (1990) Introduction: Psychology in Nesher, P. and Kilpatrick, J. (eds.) (1990) *Mathematics and Cognition. A Research Synthesis by the International Group for the Psychology of Mathematics Education,* pp. 1-13. Cambridge University Press: Cambridge.

FREUDENTHAL , H. (1991) *Revising Mathematics Education.* Kluwer Academic Publishers: Dordrecht.

FOMBIN S. A. (1990) *Students' Attitudes Towards Mathematics in Anglophone Cameroon Secondary Schools with particular reference to girls* MSc dissertation. University of Reading England.

FOMUMBOD W. D. (1993) *A possible strategy for improving the quality of mathematics teaching in Secondary Schools , Anglophone Cameroon .* Sc Dissertation. The University of Reading

GOFFREE F. (1985) The teacher and curriculum development in *For the Learning of Mathematics no. 5 pp. 26-27.*

HAGGARTY L. (1995) *New Ideas for Teacher Education.* Cassell. London

HIRSCH, C. R. and ZWENG, M. J. (1985) *The Secondary School Curriculum 1985 Yearbook.* National Council of Teachers of Mathematics: Virginia.

KILMISTER, C. W. (1972) The Nature of Mathematics in Chapman, L.R. (ed.) (1972) *The Process of Learning Mathematics*, pp 1-20. Pergamon Press: Oxford.
KITCHER, P. (1984) *The Nature of Mathematical Knowledge*. Oxford University Press: Oxford.

KOEHLER, S. D. and GROUWS, D. (1992) Mathematics Teaching Practices and Their Effects in Grouws, D. (ed.) (1992) *Handbook of Research On Mathematics Teaching Learning. (A project of the National Council of Teachers of Mathematics.)* pp. 115-126. Macmillan Publishing Company: New York.

KUYK, W. (1982) A Neuropsychodynamical Theory of Mathematics Learning, *For the Learning of Mathematics, vol. 3, no. 1,* pp 16-23.

LERMAN, S. (1989) Constructivism, Mathematics and Mathematics Education, *Educational Studies in Mathematics, vol. 20, no. 2,* pp. 211-223.

LIGHTHILL J. (1978) *Newer Uses of Mathematics*. Penguin Books. London

MARJORAM, D. T. E. (1974) *Teaching Mathematics*. Heinemann Educational Books: London.

Mathematics working group *Interim Report November 1987* H.M.S.O.

MBUNTUM F. F. (1981) *Mathematics in Cameroon West of the Mongo. A cause for Concern Cameroon Tribune of May 6, 1981, no. 359 p. 9*. AGRACAM Yaoundé

MCNAMARA. N. (1989) *Secondary School Mathematics Teaching Methodology* (unpublished) INSET Project Bamenda.

MCNAMARA N. (1990) *A report on mathematics education presented at the Annual Sectorial Conference of Inspectors in Yaoundé* (unpublished).

NDIFON J. A. (1991) *The issues of transition between Primary and Secondary School Mathematics in Anglophone Cameroon* MSc dissertation. University of Reading England.

NGES E. K. (1989) *An Investigation into some Problems of Teaching Mathematics to First Year students of Cameroon Secondary Grammer Schools with particular reference to the North West Province* F.C.P. dissertation submitted to the College of Preceptors. London.

NJEI E. A. (1988) *Some Problems of Mathematics Education in Cameroon Anglophone* MSc dissertation. University of Reading England.

NJEUMA L. D. (1986) Aid to Education in Hawes et al.(eds) (1986) *Education Priorities and Aid Responses in Sub-Saharan Africa* pp. 135-143. Overseas Development Administration. University of London Institute of Education

ORTON A. (1992) *Learning Mathematics : Issues, Theory and Classroom Practice*. 2ᶜ Cassell. London

ORTON, A. (1994) The aims of mathematics teaching in Orton, A. and Wain, G. (eds.) (1994) *Issues in Teaching Mathematics*, pp. 1-20. Cassell: London.

POLYA, G. (1957) *How to Solve it: A New Aspect of Mathematical Method* (Second Edition). Princeton University Press: Princeton, New Jersey.

Schools Council (1980) *Mathematics Teaching in Schools: Evidence from the Schools Council to the Committee of Inquiry into the teaching of Mathematics in Schools*. (Schools Council Pamphlet 17, 1980) pp. 11-15. Schools Council: London.

SFARD, A. (1991) On the Dual Nature of Mathematical Conceptions: Reflections on Processes and Objects as different sides of the same coin; *Educational Studies in Mathematics, 22,* pp. 1-36.

SKEMP R. (1986) *The psychology of learning mathematics (2ᵉ)*. Penguin Books. London.

THOMPSON, P.W. (1985) Experience, Problem Solving, and Learning Mathematics: consideration in developing curricula in Silver, E. A. (ed) (1985) *Teaching and Learning Mathematical Problem Solving: Multiple Research Perspectives*. Lawrence Erlbaum: Hillsdale, NJ; cited by Underhill, R. G. and Jaworski, B. (1991).

TULLOCH S. (ed.) (1993) *The Reader's Digest Oxford Complete Wordfinder*, The Reader's Digest Association Limited. London.

UNDERHILL, R. G. and JAWORSKI, B. (1991) *Contrustivism and Mathematics Education: A discussion*. Centre for Mathematics Education, Open University: Milton Keynes.

WILDER, R. (1972) The Nature of Modern Mathematics in Lamon, W.E. (ed.) (1972) *Learning and The Nature of Mathematics*, pp. 35-48. Science Research Associates, INC: Chicago.

WILSON B. J. (1992) Mathematics in Africa in Morris R. and Arora M. S. (eds.) (1992) *Studies in Mathematics Education vol. 8: moving into the twenty-first century* pp 125-127. UNESCO. Paris

ZAWADOWSKI, W. (1990) The Changing Scene of Mathematics Education in Poland, 1970-1988 in Wirszup, I. and Streit, R. (eds.) (1990) *Developments in School Mathematics Education Around the World*, pp. 234-261. National Council of Teachers of Mathematics: Preston.