1. RESEARCH FRAMEWORK

1.1. Introduction

The nine-year compulsory education has been fully implemented for nearly twenty years. Despite the optimistic expectations of the community at the early stages of the implementation, the quality of education has aroused the concerns of the public in general and educators in particular. The Board of Education commissioned two research teams in The Chinese University of Hong Kong and the University of Hong Kong to review compulsory education with a view to identifying ways of improving it. At the Sixth-form level, the University Grants Committee also commissioned the POSTE study to look at the quality of the intended and implemented curriculum, language teaching and to forecast the demands for tertiary places (Cheng, Lai, Lam, Leung, & Tsoi, 1996). It was no surprise, therefore, that the Education Commission Report No. 7 (1996) focussed on the quality of education. All these studies have provided the academic circle with useful information which will, undoubtedly, form the basis of similar and future follow-up research.

Of particular relevance to the present study is the finding that children's proficiency in mathematics deteriorates as they move up the grade levels, and mathematics, just the next to English, is the subject which children find most difficult (Wong, H.W., 1996). The school curriculum, including the corner-stones of literacy and numeracy, is one of the many factors which shape the quality of education. They have been explicitly stated as the first aim relating to learning skills (the preceding ones concern opportunity and general aims) in the *Statement of Aims* published by the Education and Manpower Branch in 1993. It is recognised that the quality of mathematics education directly affects learning in other scientific disciplines, and thus it influences the development of human resources in the field. This is seen most clearly in a highly technological society such as Hong Kong where every citizen needs to become mathematically literate (NRC, 1989).

In response to the need for a review and reform in the mathematics curriculum in Hong Kong, a Joint Working Party, consisting of committee members from both the Curriculum Development Council and the Hong Kong Examinations Authority, was set up in 1994 to review the mathematics curriculum. It came to the conclusion that "there should be a holistic review involving researches and situational appraisal, of the primary to sixth-form Mathematics Syllabuses". In fact, situational analysis is the first step in curriculum development (Lawton, 1989;

Skilbeck, 1984). Popham, (1993) points out that a review should cover the following tasks:

(a) assess the weaknesses and strengths of the present curriculum and identify areas which need to be improved;
(b) understand the social and political developments in the society;
(c) depict a clear picture of how teachers teach and how students learn;
(d) detail recent development in the subject discipline;
(e) find out the expectations of students, schools, teachers and employers towards the school education.

As a matter of fact, a comprehensive appraisal was performed elsewhere before actual curriculum reform commenced. *Mathematics Counts* ("Cockcroft's report" of the Committee of Inquiry into the Teaching of Mathematics in Schools: Cockcroft, 1982) of the U.K. and *Everybody Counts* (Report to the Nation on the future of mathematics education: NRC, 1989) of the U.S.A. are two famous reports on mathematics education.

With the setting up of the Ad-hoc Committee for Holistic Review of the Mathematics Curriculum under the Curriculum Development Council, a curriculum reform on the Hong Kong school mathematics was formally launched. While the primary and secondary mathematics curricula were revised in 1996 and 1997, there is an urgent need for an appraisal of the current state of the mathematics curriculum. Research on the strengths and weaknesses of the present curriculum and views of various "end-users" as well as stakeholders can provide useful information not only for curriculum planners in the development of a new curriculum, but can also generate first-hand data which can improve teaching and learning at the classroom level. On the other hand, the analysis of worldwide curriculum trends can also throw insight on the local scene. Thus, research in both directions is timely when the mathematics curriculum in Hong Kong is undergoing a reform and a holistic review is instigated.

It was with this intention that the Education Department commissioned the present study which was conducted from April 1998 to June 1999.

1.2. Research questions

In order to achieve the objectives set, the following tasks were set:

(a) To study students' views at various learning stages on (i) their attitudes towards learning mathematics; (ii) their actual effort made in learning mathematics; (iii) their comments on the learning experiences; and (iv) the problems they face in learning mathematics;

(b) To study parents' views on the current school mathematics curriculum and their expectation for changes at various learning stages;

(c) To study teachers' views on (i) the current school mathematics curriculum at various learning stages; (ii) the problems they face in teaching; (iii) their expectation on future development; and (iv) the support they will need in the implementation of a new mathematics curriculum;

(d) To solicit views of various key stakeholders, including employers (from the human resources perspective) in various sectors of the employment field, educators of tertiary institutions/universities, etc., on (i) their general opinions of school mathematics education; (ii) the strengths and weaknesses of school-leavers in mathematics-related abilities; and (iii) mathematics-related abilities that need to be further developed; and

(e) To compile suggestions made in another research [(1)] and feedback collected in consultation to make recommendations (with alternatives, and the pros and cons for each alternative) on (i) the overall aims of future school mathematics education, aims and objectives of the future school mathematics curriculum at various learning stages; (ii) the design and general layout of mathematics curriculum at various learning stages; (iii) modes of courses and modes of assessment; (iv) changes necessary to achieve the aims; and (v) strategic plans, both short-term and long-term, in implementing the recommendations.

1.3. The Research Plan

In order to collect data for the above research questions, the following research framework was constructed (Figure 1).

[(1)] "Research 1": Comparative study on the mathematics curricula of major Asian and western countries commissioned by the Education Department conducted by the same research team.

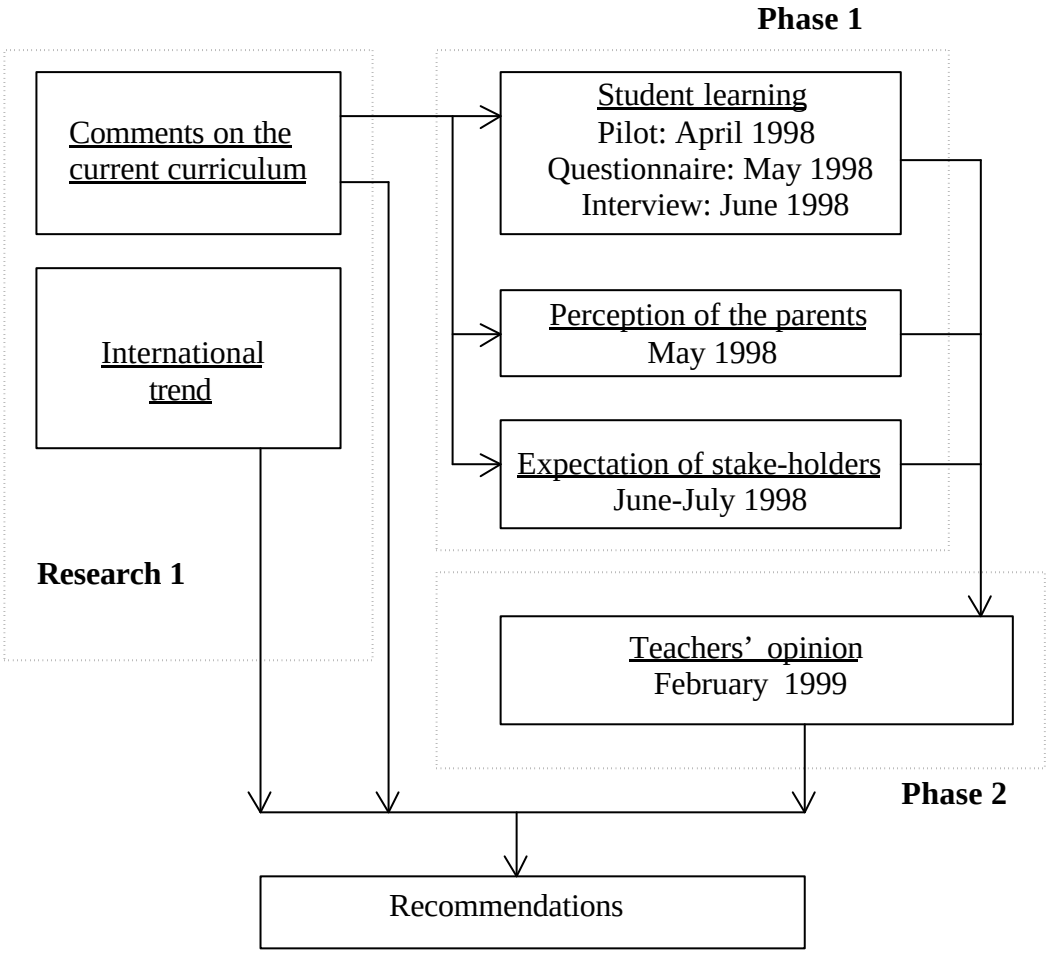

Fig. 1 The Research Plan

1.4. Methodology

Both quantitative and qualitative methods were utilised since the data to be collected were multifarious. The methodology used is given in Table 1 and the questionnaires used are given in the appendices. Four basic research studies conducted by team members were also incorporated into the present one though these studies are still owned by the researchers. They are:

(a) The IEA Third International Mathematics and Science Study (TIMSS): Frederick Koon-Shing Leung. Funded by Research Grant Council and The Hang Seng Bank Limited Hong Kong.

(b) Mathematics Curriculum Reform for Universal Education: Development of Instruments: Ngai-Ying Wong, Chi-Chung Lam & Patrick Ka-Ming Wong. Funded by Direct Grant, Social Science and Education Panel, The Chinese University of Hong Kong.

(c) Learning Styles and Difficulties Encountered in Mathematics Learning among

Hong Kong Students: Ngai-Ying Wong, Chi-Chung Lam & Patrick Ka-Ming Wong. Funded by Direct Grant, Social Science and Education Panel, The Chinese University of Hong Kong.

(d) Teachers' Conception of Mathematics and Mathematics Teaching in Mainland China and Hong Kong: Ngai-Ying Wong, Chi-Chung Lam, Patrick Ka-Ming Wong and Yun-Peng Ma. Funded by Direct Grant, Social Science and Education Panel, The Chinese University of Hong Kong.

Results in Research 1 (Comparative study on the mathematics curricula of major Asian and western countries commissioned by the Education Department conducted by the same research team) were ultilised in the present research both in setting up of the research framework and in the design of questionnaire items. Likewise, results in phase 1 in the present research were utilised in the design of phase 2 of the research too.

Table 1. Methodology of the research

Research questions	Methodology employed
(a) To study students' views at various learning stages on (i) their attitudes towards learning mathematics; (ii) the actual effort paid in learning mathematics; (iii) their comments on the learning experiences; and (iv) the problems they face in learning mathematics.	A questionnaire on students' attitudes towards learning mathematics, their beliefs in mathematics (including its usefulness) and their learning habits was administered to a random sample of 90 primary and 50 secondary schools. In each of these schools, two classes were selected from the grade levels P.3, P.6, S.3, S.4 or S.6. Semi-structured group interviews (in groups of 4 students) were conducted for 3 groups from each of the grade levels P.3, P.6, S.3, S.4 and S.6. A total of 15 groups (60 students in all) were sampled from 12 different schools among which 5 classes were taken from schools of high academic standard, 5, from those of average academic standard, and 5, from those of low academic standard, based on data of school banding. These data were supplemented by a content analysis of examiners' reports of major public examinations.

Table 1 (continued). Methodology of the research

Research questions	Methodology employed
(b) To study parents' views on the current school mathematics curriculum and their expectation for changes at various learning stages.	The parents of the above random sample of students from 90 primary and 50 secondary schools were invited to respond to a questionnaire on their views of the current school mathematics curriculum and their expectation for changes at various learning stages.
(c) To study teachers' views on (i) the current school mathematics curriculum at various learning stages; (ii) the problems they face in teaching; (iii) their expectation on future development; and (iv) the support they will need in the implementation of a new mathematics curriculum.	The chairpersons, or their representatives, of the mathematics panels of the above sample of 90 primary and 50 secondary schools were invited to respond to a questionnaire. Follow-up interviews were conducted among teachers from 5 primary schools and 5 secondary schools.
(d) To solicit views of various key stakeholders, including employers (from the human resources perspective) in various sectors of the employment field, educators of tertiary institutions/universities, etc., on (i) their general opinions of school mathematics education; (ii) the strengths and weaknesses of school-leavers in mathematics-related abilities; and (iii) mathematics-related abilities that need to be further developed.	Semi-structured interviews were conducted with persons from the human resources department of 5 enterprises in the field of science and technology (and related areas). Semi-structured interviews were conducted with 17 lecturers in related departments (including natural sciences, social sciences, computer science and engineering) in tertiary institutions. One current and/or ex-members (1995-98) from each of the Mathematics subject committees (primary, secondary and sixth-form) of the Curriculum Development Council, one curriculum planner in the science or humanity field, together with mathematics subject officers of the Hong Kong Examinations Authority, were also interviewed.