JAPAN INTERNATIONAL COOPERATION AGENCY

MINISTRY OF EDUCATION THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

THE MASTER PLAN STUDY

FOR THE DEVELOPMENT OF SCIENCE AND MATHEMATICS

IN THE PRIMARY AND SECONDARY LEVELS

IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT

SUMMARY REPORT






FEBRUARY 2005

KRI INTERNATIONAL CORP.

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JR
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EXCHANGE RATE
(As of October 2004)
US$1.00 = ¥106.17= Rs.104.06

PREFACE

In response to a request from the Government of the Democratic Socialist Republic of Sri Lanka, the Government of Japan decided to conduct the Master Plan Study for the Development of Science and Mathematics Education in the Primary and Secondary Levels and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Toshikazu Tai of KRI International Corp. from November 2002 to February 2005.

The team held various discussions with the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka and conducted field surveys and analysis. This final report has been prepared on the basis of the studies conducted during the past two years.

I hope that this report will contribute to further improvement in the education sector and to the enhancement of friendly relationship between the two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Democratic Socialist Republic of Sri Lanka for their close cooperation extended to the Study.

February 2005

Kazuhisa MATSUOKA,
Vice-President,
Japan International Cooperation Agency

February 2005

Mr. Kazuhisa Matsuoka
Vice President
Japan International Cooperation Agency (JICA)
Tokyo, Japan

Dear Mr. Kazuhisa Matsuoka,

Letter of Transmittal

We are pleased to submit to you the Final Report on "The Master Plan Study for the Development of Science and Mathematics in the Primary and Secondary Levels in the Democratic Socialist Republic of Sri Lanka". Under the contract with your esteemed organization, the Study was carried out for the 28-month period from November 2002 to February 2005.

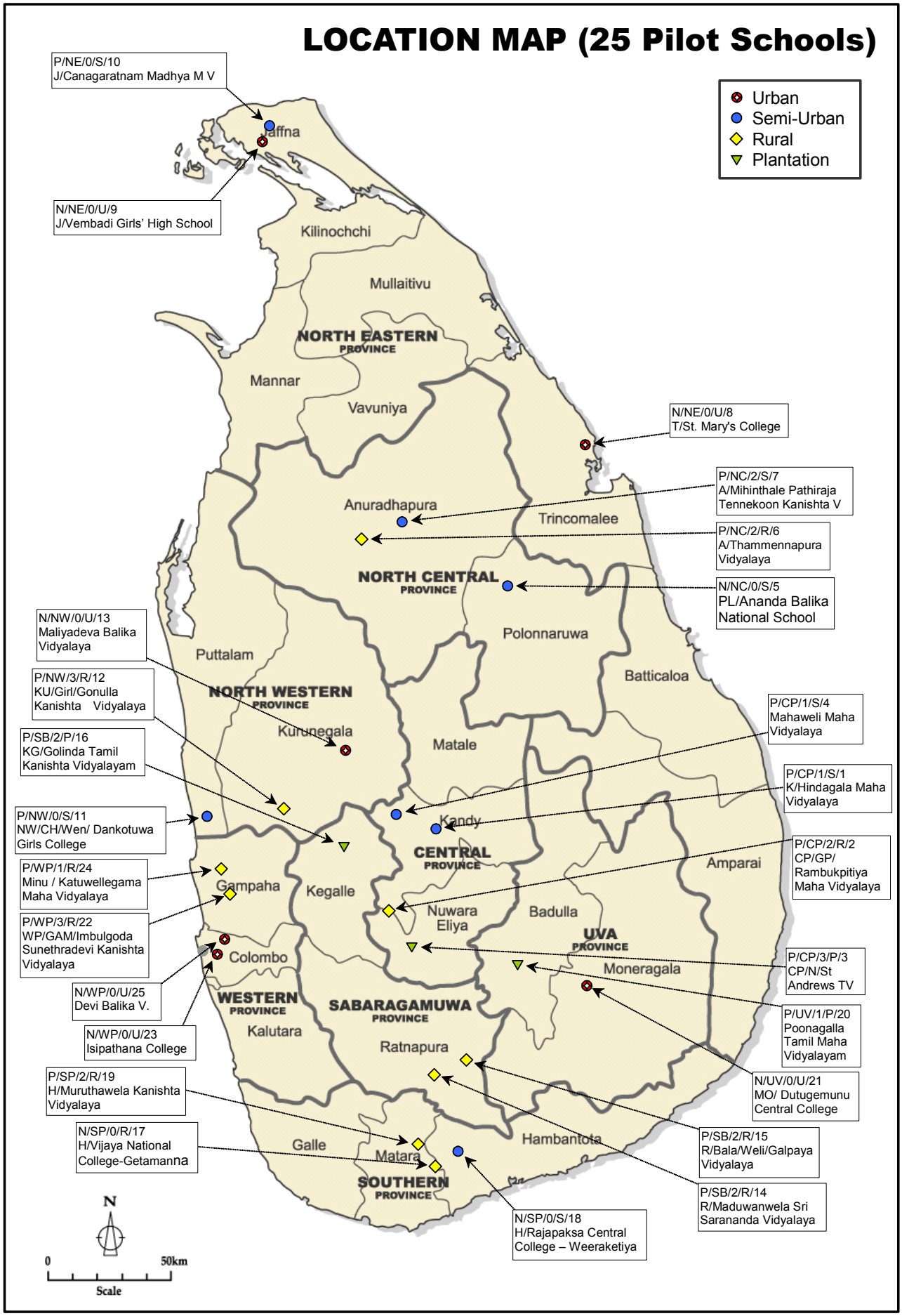
The Study formulated "The Master Plan for the Development of Science and Mathematics in the Primary and Secondary Levels" through the analysis on the current education sector as well as socio-economic aspects and the implementation of the Pilot Project. Based on the lessons learnt from the Pilot Project, the Master Plan was formulated to improve science and mathematics education in the primary and secondary levels emphasizing the school-based educational Kaizen activities.

We wish to take this opportunity to express our sincere gratitude to the Embassy of Japan, JICA, the JICA Advisory Committee members, and the JICA expert. We also wish to express our deepest gratitude to the Ministry of Education and the National Institute of Education, and concerned officers of related agencies for the courtesies and cooperation extended to the team during the course of the Study.

Very truly yours,

Toshikazu Tai
Team Leader

LOCATION MAP (25 Pilot Schools)



THE MASTER PLAN STUDY FOR THE DEVELOPMENT OF SCIENCE AND MATHEMATICS IN THE PRIMARY AND SECONDARY LEVELS IN THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

FINAL REPORT: SUMMARY REPORT

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Abbreviations

AAT	Academic Ability Test
ADB	Asia Development Bank
BS	Baseline Survey
CCD	Centre for Curriculum Development
CLC	Computer Learning Center
CRC	Computer Resource Center
DDE	Deputy Director of Education
DFID	Department for International Development
DSD	Development of Schools by Division
EMIS	Educational Management Information System
ERA	Environmental Related Activities
GCE A-Level	General Certificate of Education Advanced Level
GCE O-Level	General Certificate of Education Ordinary Level
GDP	Gross Domestic Product
GEP	General Education Project
GEP2	Second General Education Project
GER	Gross Enrollment Ratio
GNP	Gross National Product
GOJ	Government of Japan
GOSL	Government of Sri Lanka
GTZ	German Technical Assistance Agency
ICT	Information and Communications Technology
ISA	In-Service Advisor
IT	Information Technology
JICA	Japan International Cooperation Agency
MOE	Ministry of Education
MTET	Ministry of Tertiary Education and Training
NAPITSE	National Policy on Information Technology in School Education
NATE	National Authority on Teacher Education
NCOE	National College of Education
NEC	National Education Commission
NEIKA	National Educational Initiative of Kaizen Activities
NER	Net Enrollment Ratio
NETS	National Evaluation and Testing Service
NIE	National Institute of Education
PEA	Provincial Education Administration
PPS	Post Pilot Survey
Q & A	Questions and Answers
QE	Quality Education
QEC	Quality Education Circle
QS	Questionnaire Survey
SBA	School-Based Assessment
SBM	School-Based Management
SDS	School Development Society

SEIKA	School Educational Initiative of Kaizen Activities
SEMP	Secondary Education Modernization Project
SWAp	Sector Wide Approach
TC	Teachers' Center
TETD	Teacher Education and Teacher Deployment Project
TIP	Teacher In-Service Project
TTC	Teachers' Training College
UNICEF	United Nations Children's Fund
WB	World Bank
ZEIKA	Zonal Educational Initiative of Kaizen Activities

CHAPTER I

INTRODUCTION

1.1 Study Background

Sri Lanka has made a remarkable success in human development indicators since independence. Life expectancy marked 72 which are high as comparable to the rate of middle-income countries. Adult literacy rates in terms of minimal language competency are 92% with a high level of gender parity. In the education sector, completion rates for primary and secondary school are around 98% and 83% respectively (2001)[1].

However, the core problem in education sector is considered to lie in its 'quality' which is clearly represented in the low pass rate of science subjects in O-Level and A-Level examinations, e.g. 42% in *mathematics*, 49% in *science* compared to 80% in *history* and 77% in *social studies* (O-Level); 51% in *chemistry*, 55% in '*combined mathematics'* compared to 90% in *business studies* (A-Level). Accordingly only less than 20% of the all candidate students qualify for university in science stream.

Under this situation, the Government of Sri Lanka requested the technical assistance for the Master Plan Study for the Development of Science and Mathematics in the Primary and Secondary Levels (the Study) to the Government of Japan (GOJ). In response to the request, the GOJ dispatched a preliminary survey mission in August 2002 and discussed the contents of the Study with GOSL, the results of which are compiled in the Minutes of the Meeting (M/M) and the Scope of Work (S/W) signed between the Ministry of Education (MOE)[2] and the Japan International Cooperation Agency (JICA).

Following the agreement between the two governments, the implementation of the Study was entrusted to KRI International Corp and commenced from November 2002.

1.2 Objectives and Organization

1.2.1 Study Objectives

The objectives of the Study are:

- To formulate a master plan to improve the quality of science and mathematics education in primary and secondary levels; and,

[1] 'The Development of Education' Ministry of Education, Aug 2004
[2] Formerly 'Ministry of Human Resources Development, Education and Cultural Affairs'

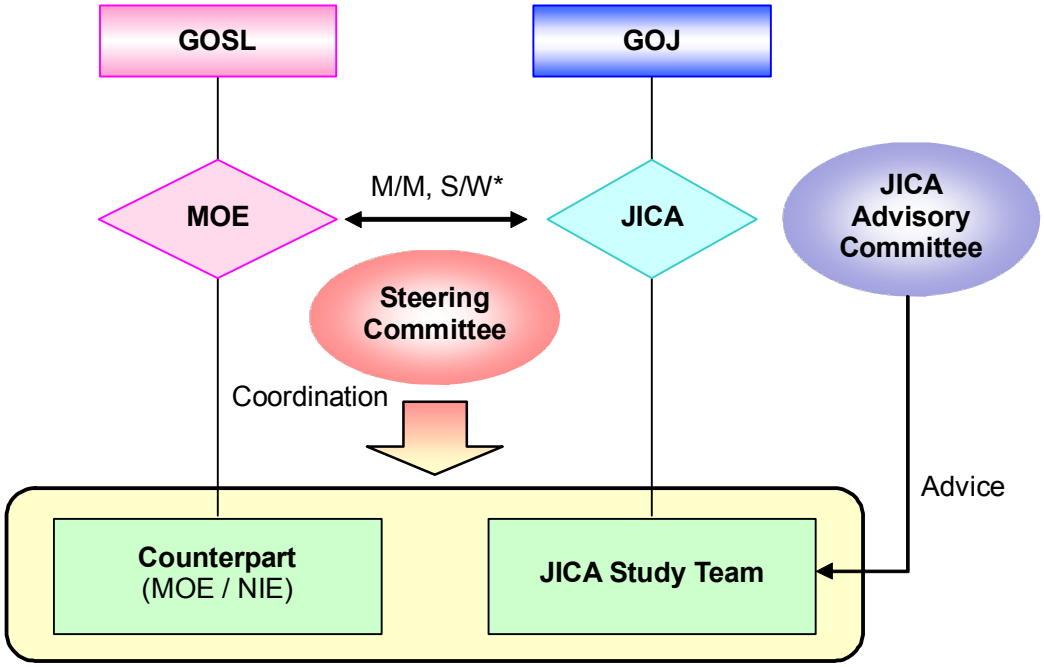
- To help strengthen the planning and implementing capacity of the Counterpart Personnel through the implementation of the Study.

The target area covered by the Study is the whole country of Sri Lanka.

1.2.2 Organizations

The Ministry of Education is the counterpart agency of the Study, and the Planning and Performance Review Division is in charge of coordination. For effective implementation and ultimately attaining the Study objectives, Counterpart (C/P) members are selected from both MOE and the National Institute of Education (NIE), and assigned to the JICA Study Team. The field survey and analysis for the Study have been conducted by the JICA Study Team experts in collaboration with the C/P through the study period.

In addition, a Steering Committee was established as a coordination body among the organizations and agencies related. On the Japanese side, an Advisory Committee was set up in Tokyo for providing necessary advice to the JICA Study Team. The organizational structure of the Study has described as Figure1.1.



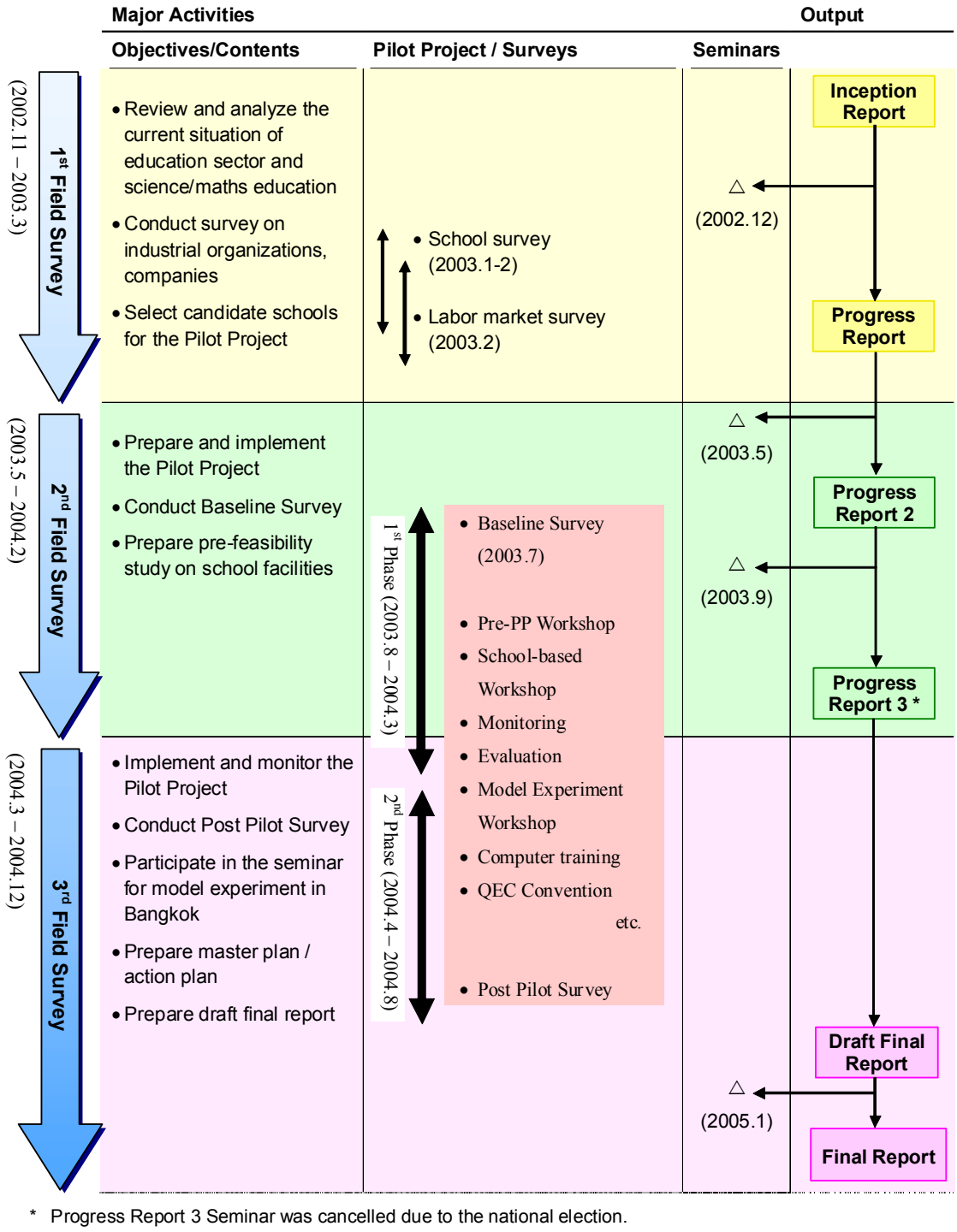
* M/M: Minutes of Meeting
S/W: Scope of Work

Source: JICA Study Team

Figure 1.1 Organization of the Study

1.3 Major Activities

The Study was conducted during the period of November 2002 to January 2005. The major activities during the study period are summarized in Figure 1.2.



* Progress Report 3 Seminar was cancelled due to the national election.

Source: JICA Study Team

Figure 1.2 Overall Work Flow of the Study

CHAPTER II

EDUCATION SECTOR

2.1 Government Strategy and Programs

2.1.1 Strategic Direction

(1) Development Policy and Education Reform

After the parliamentary election held on April 2nd, 2004, a new economic policy framework entitled 'Creating Our Future, Building Our Nation' was issued by the new administration in July 2004.

The new policy framework puts a high priority to create a 21st century workforce through educational reforms, human resources and skills development, and improving productivity with a new ethic towards performance excellence and innovation. Education is recognized as being central to economic growth and poverty reduction, and the government committed to transform and modernize the education system through the education reforms, with the objective of equipping Sri Lankan children with the requisite knowledge, skills and attitudes suited to face the rapid changes occurring in the socio-economic and global landscape of the 21st century.

The National Education Commission (NEC) in 1997 published the paper 'Reforms in General Education.' This paper became the basis for education reforms that were implemented over the following five years. The objectives of the reform were:

- To extend educational opportunity
- Improve the quality of education
- Provide good management and resources

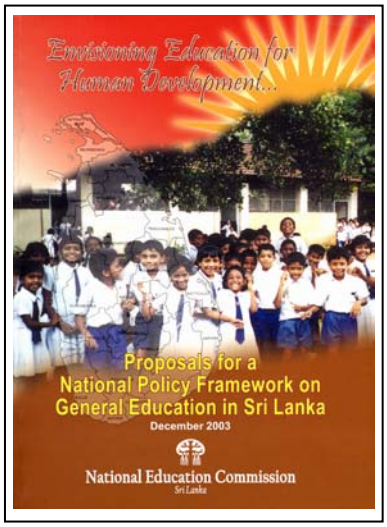
Through 2002 and 2003, NEC developed a new set of reform policy proposals that were published in December 2003 as the document: 'Envisaging Education for Human Development - Proposals for a National Policy Framework on General Education.'

The document is now the blueprint for general education reform in Sri Lanka for the next five years and the following are the major contents related to our study.

<u>Promotion of Mathematics, Science and ICT Education at Secondary Level</u>

The three subjects should be strengthened and expanded by:

- Establishing a science subject for grades 6-11 with a revised and expanded curriculum
- Activity-based interactive teaching and learning methods in science and mathematics
- Provision of adequate laboratory and information technology facilities
- Strengthening SBA with respect to assessing practical work, projects and assignments
- Extending the option of English medium for science students
- Popularizing science education through the media, science centers, science parks, science camps
- Introducing computer literacy in the core curriculum for secondary schools and in teacher education
- Providing facilities for '*Information Technology'* as a subject for GCE O-Level and GCE A-Level examinations
- Making facility improvements to the present Type 1C schools to upgrade them for the teaching of science and mathematics at GCE A-Level



(2) Education Sector Wide Approach (SWAp)

The IBRD and MOE have recently had discussions regarding a change in the nature of their assistance as an education development partner to Sri Lanka. The IBRD Aide Memoire[3] outlined an approach that re-focuses Bank assistance from individual projects such as GEP1 and TETD to an education sector wide approach (SWAp). This was seen by the MOE as the most appropriate way to address the system-wide development issues faced by the Sri Lankan education system.

The key characteristics of the proposed sector wide approach will consist of:

- A comprehensive education sector development plan
- A multi-year education expenditure framework, and a long-term, output oriented education planning horizon
- Streamlined management system at central, provincial, and school level, including capacity building at each level

[3] IBRD Preparatory Mission Draft Aide Memoire July 26-August 12, 2004

2.1.2 Sector Development Plans

(1) Primary Education Development Plans

Since Five-Year Plan for Primary Education 2000-2004 will end in the end of 2004, MOE is now preparing the next Five-Year Plan for Primary Education 2005-2009, using bottom-up planning mechanism, in which Zonal Offices prepare zonal plans first, then Provincial Offices prepare provincial plans by consolidating zonal plans, and finally MOE compiles a national plan by consolidating provincial plans.

In the next Five-Year Plan for Primary Education 2005-2009, MOE plans to continue educational reform in the primary cycle, mainly through the following measures:

- Introducing kid's library, a learning activity room, and a play area in primary schools;
- Improving teachers' capacity on activity-based, learner-centered teaching through a) School-based Teacher Development Program using In-School Training, and b) Teachers' Quality Circles in the divisional level;
- Improving health and nutrition situation for primary school students by providing adequate toilets, safe drinking water, hygiene and nutrition education; and
- Introducing Child Friendly Schools[4] in 30% of primary schools in selected 7 districts[5] in collaboration with UNICEF from 2005.

(2) Secondary Education Development Plan 2004-2008

Following the document, 'Five-Year Plan for Primary Education in Sri Lanka 2000-2004' to facilitate the reforms of the Primary Cycle, the MOE has released a document 'Five Year Plan for the Development of Secondary Education 2004-2008'. This document outlines a plan to systematize the implementation of secondary reforms to achieve set targets.

1) Access to Secondary Education

All students are entitled to quality secondary education within a reasonable distance of their home.

[4] Child Friendly Schools (CFS) are characterized as having the following 12 key determinants: 1) guarantee of children's rights, 2) learning quality, 3) reducing students' dropouts and absenteeism, 4) protective environment for students, 5) health and nutrition including life skills education for adolescents, 6) water, sanitation and hygiene, 7) early childhood development, 8) trained and motivated teachers and primacipals, 9) sports and recreational activities, 10) gender sensitiveness, 11) inclusiveness, and 12) children's and parents' participation.

[5] Nuwara Eliya and Mathale (Central Province); Badulla and Moneragala (Uva Province); Hambantota (Southern Province); Anuradhapura (Northern Central Province); and Rathnapura (Sabaragamuwa Province)

2) Deployment of Teachers

Teacher excesses and shortages provide a teacher deployment problem. Teacher shortages are particularly noticeable in Physical Sciences and Mathematics A-Level subjects. There is generally a shortage of Tamil medium secondary teachers.

3) Teaching Materials and Equipment

There have been distribution delays of materials and equipment to remote areas. Library facilities are also poor in these areas. There is a lack of remedial reading material and suitable material for teaching in the English medium. There are also equipment deficiencies at ICT Centers.

4) School-Based Management

SBM although promised in the 1997 reforms has not yet been implemented. MOE intends to give individual schools more autonomy in the future.

5) Infrastructure

To improve access and equity, a detailed year-by-year program for secondary school infrastructure requirements for 2004 –2008 is included in the Plan.

2.1.3 Collaboration with External Agencies

Several education sector projects are implemented under cooperation with external agencies. Only the projects that are supportive or related to the JICA Study are explained hereunder.

(1) Ongoing Projects

1) IBRD Projects

Second General Education Project: GEP2 (IBRD) 1997 – 2004 (extended to October 2005)

The main objective of this large top-down project is to promote quality, equity and efficiency of the system particularly for grades 1-9. This was achieved by producing new curricula and materials in all subjects and in-service teacher training and reorganization, renovation and refurbishment of Type 2 schools. Libraries were renovated, librarians trained and new books supplied. There was also management training at all levels.

Teacher Education and Teacher Deployment Project: TETD (IBRD) 1996 – 2004 (extended to October 2005)

The main objective of this project is to improve the quality, effectiveness and efficiency of the teaching service. This was achieved by:

(i) Rationalization of teacher recruitment, (ii) deployment and training, (iii) strengthening teacher training authorities by focusing teacher training in Universities, NCOE and NIE.

2) ADB Projects

Secondary Education Modernization Project: SEMP 2001-2005

SEMP in many ways complements GEP2 in that it concentrates on grades 10-13 and is heavily concerned with examination reform through SBA. Many of its inputs e.g. curriculum strengthening in science and mathematics, upgrading Type 1C schools to Type 1AB schools with science labs, ICT inputs are relevant to our study.

The main objective of this project is to raise national examination results for both O-Level and A-Level students. This is to be achieved by quality improvements in grades 10-13, access to quality instruction for disadvantaged schools and efficiency in management and supervision.

2.2 Development Challenges

The current situation of the education sector, focusing on science and mathematics education is discussed in this sub chapter. This discussion includes the accomplishments and problems of the sector from the viewpoint of quality, equity, and planning and management.

2.2.1 Quality of Education

(1) Curriculum

1) Current Situation

The suggested curriculum reforms under the 1997 General Education Reforms document have now taken place and preliminary moves are underway to commence another cycle of reforms especially at the secondary level. This new cycle of reforms should commence in 2005. The Centre for Curriculum Development (CCD) at NIE is responsible for the design and development of the school curriculum at Primary, Junior Secondary, and Senior Secondary Levels.

2) Review of Syllabuses

The syllabuses are well presented and detailed. However, there are too many topics in the Junior Secondary, O-Level and A-Level syllabuses and the degree of difficulty of some A-Level content is high. Many teachers have problems in completing all the topics in a particular syllabus. As more time in the school calendar is required to be given to SBA activities, it will be necessary to consider modifications to most syllabuses to allow for this change. There is little mention of ICT in the Junior Secondary, O-Level and A-Level syllabuses.

(2) Textbooks and Instructional Materials

1) Textbooks and Distribution System

Textbooks are provided free to schools for distribution to all students island-wide up to grade 11. These include Sinhala and Tamil versions of each book in the various school subjects from grades 1-11, English language books for English as a second language classes in grades 3-11 and English medium classes in grades 6, 7 and 8. In grades 12 and 13, some students buy their own textbooks and others are distributed to students under various schemes.

SEMP has provided several Type 1AB schools with a number of English medium reference books in biology, chemistry, physics and mathematics.

Although NIE officers design and prepare the syllabuses and teachers' guides they do not write the textbooks. Teams of teachers write the textbooks with some assistance from education officers and university people.

2) Teachers Guides and Reference Materials

Teachers Guides

NIE Curriculum Officers produce Teachers' Guide(s) corresponding to each syllabus they prepare. The Teachers Guides provide learning objectives for each subject, sequence of topics, allocation of time to topics, teaching notes on content, learning/teaching strategies and assessment details. From subject to subject, they vary in detail with the Science Teachers' Guides providing more information for the teacher than the Mathematics Teachers' Guides. There was also evidence to suggest lack of correlation between Teachers' Guides and textbooks in some cases.

Reference Materials

Sri Lankan teachers have little access to reference material in the Sinhala or Tamil medium. There are some small publications in science and mathematics on selected topics but these have limited circulation. With the upgrading of Type 1AB school libraries, GEP2 has provided a good range of English medium Science and Mathematics reference books. As well as these reference books, some schools have limited material on CD, DVD and video for A-Level classes. There is little ICT material in schools.

(3) Teacher Competence and Teaching Methods

Teachers play key roles in improving education in schools. Without improving teachers' motivation and capacity for teaching, education reform will not bear any fruitful results at the school level.

Since teacher's qualifications are only a small part of teachers' capacity to teach, it is important to assess the level of teachers' actual capacity to teach. School Survey conducted by JICA Study Team in 2003 shows that according to the

principal's evaluation, teachers' teaching capacity is ranked at the highest in private schools, and teachers in urban schools are perceived to have higher teaching capacity than those in rural schools.

In Sri Lanka, many school children suffer not only from shortage of qualified teachers, but also from teachers' absenteeism. While MOE can set the required teaching time for each subject, it is up to teachers how many minutes are actually allocated for education, because teachers are often absent from classrooms due to various reasons.

Education reform in 1997 recommended introducing student-centered learning especially in the primary level, which requires teachers to learn and use various new teaching methods in classrooms. During implementing the Pilot Project, JICA Study Team conducted a survey on the actual teaching methods applied in science and mathematics lessons at 6 pilot schools. The summary result of the survey is shown in Table 2.1, which indicates that while student-centered activities are more practiced in primary level than in secondary level, still traditional teaching methods such as lecturing by teachers and exercise by students are prevailing especially in secondary level.

Table 2.1 Average Time Spent for Various Teaching Methods (%)

Subject	Grade	Teacher-centered teaching methods						Student-centered teaching methods				Inactive Time
		Lecturing by teacher	Q & A between teacher & students	Exercise by students	Experiment Demonstra-tion by Teacher	Other	**Sub-Total**	Discussion among students	Presentation by students	Experiment by Students	**Sub-Total**	
Mathematics	4	23.4%	20.0%	45.4%	0.7%	0.0%	**89.6%**	2.2%	2.7%	3.2%	**8.1%**	2.3%
	8	34.7%	16.1%	33.2%	1.9%	0.6%	**86.5%**	3.0%	5.0%	0.0%	**7.9%**	5.5%
	10	30.5%	8.0%	41.8%	0.4%	0.0%	**80.8%**	5.0%	1.7%	0.2%	**6.8%**	12.4%
	All	30.0%	14.3%	39.8%	1.0%	0.2%	**85.4%**	3.4%	3.2%	1.0%	**7.6%**	7.1%
Science	4	18.4%	18.0%	20.0%	5.0%	2.0%	**63.4%**	3.0%	7.1%	23.4%	**33.5%**	3.1%
	8	33.5%	18.0%	19.0%	7.0%	0.6%	**78.2%**	2.6%	7.0%	6.8%	**16.4%**	5.4%
	10	30.9%	12.9%	26.0%	4.7%	0.0%	**74.5%**	2.2%	3.3%	9.3%	**14.8%**	10.6%
	All	28.3%	16.2%	21.8%	5.6%	0.8%	**72.7%**	2.6%	5.7%	12.5%	**20.7%**	6.6%

Source: Survey on Teaching Time, JICA Study Team

(4) ICT in Education

1) Government Policy

The National Policy on Information Technology in School Education (NAPITSE) of the Government of Sri Lanka was issued in 2001 by the IT Unit of MOE. It emphasizes ensuring ICT literacy for all school leavers and the use of ICT throughout the curriculum at secondary level.

2) ICT for Science and Mathematics Education

The major problems that face ICT for science and mathematics education are as follows:

Insufficient ICT literacy among teachers

Low ICT skills of teachers prohibit them from using ICT in their teaching practices. Lack of applicable teaching and learning material is another reason

why ICT tools such as Excel are not widely used in science and mathematics education. As mentioned earlier, English is a notable obstacle to many teachers in adopting the necessary ICT skills, as the interface language of applications and resource materials are predominantly English.

Lack of teaching materials

The overall goal of the use of ICT is to support developing experimental and student-centered learning. Educational software is prepared to help the understanding of key concepts and support the promotion of multiple assessment modalities. Spreadsheet and text processing software should find extensive use whenever student reports are made, especially in A-Level science education.

In addition lack of Sinhala and Tamil media software and resource materials makes it difficult for students especially below O-Level to follow instructions or the course of educational software.

Lack of equipment, poor maintenance and low quality of facilities

The majority of government schools still lack computer laboratories. Together with poor facilities in many schools (no air-conditioning, no shelter from insects or humidity), poor basic maintenance may lead to deterioration of equipment and endanger progress in developing ICT literacy.

Lack of Internet access

High cost of Internet access and lack of cable connections in rural areas result in very few schools with access to the Internet. Strengthening the necessary network infrastructure requires government interventions and strong support.

(5) Assessment System

1) Public Examination System

The National Evaluation and Testing Service (NETS) administers the Public Examination System. There are three public examinations conducted each year, namely:

Grade 5 Scholarship Examination

This examination is held in August every year and has two major objectives:

One is the provision of financial assistance scholarships (bursaries) to the parents of clever students from disadvantaged economic or geographical backgrounds. The other is that Scholarship holders together with those who ‘qualify’ are eligible to go to popular schools.

However, the small number of scholarships being offered is an access and equity problem as the number of students sitting the examination has risen in recent years and the number of scholarships has remained the same. Additional scholarships need to be offered to give more disadvantaged students an opportunity to have a better education.

GCE O-Level Examination

The examination is held in December each year at the end of grade 11 and more than 330,000 school students sat the examination in 2003. A total of 59 subjects are offered in the curriculum.

The main issues for the GCE O-Level examinations are: Poor pass rates in *'science and technology'* and *mathematics*. These are still low and require improvements in teaching methods, syllabus modifications, provision of more instructional materials and the high dropout rate between O-Level and A-Level studies. This problem is linked to the low pass rates and will only improve if the pass rates improve.

GCE A-Level Examination

The examination is held in April/May each year at the end of grade 13 and more than 171,000 school students sat the examination in 2004. Government policy states that this examination is to serve a dual purpose, an attainment examination and a means of selection to University.

The main issues for the GCE A-Level examination are; a) poor pass rates particularly in *chemistry*, *physics* and '*combined mathematics'*. These many able students miss out on university education and have to seek employment or other forms of further training; b) and there are limited places at universities compared with those who qualify from the A-Level examination. This creates intense competition for places and examination-oriented teaching.

2) School-Based Assessment (SBA)

Both NIE and NETS are involved in SBA. NIE is responsible for SBA in grades 6-9 and NETS for SBA in grades 10-13. SBA was introduced to schools as part of the 1997 Reforms. At present, SBA has been implemented up to O-Level in the school system and is in the final implementation stages at A-Level. Parallel SBA grades were reported for the first time on the 2002 O-Level Examination Certificate. Parallel SBA grades will be reported on the 2005 A-Level Examination Certificate.

However, there have been problems with SBA. Most teachers now understand the principles behind SBA but many are still unsure of procedures. Research by NETS has also shown that there is a lack of uniformity of grading across schools. Also, some teachers, particularly in mathematics, are still using the

results of various short tests rather than assignments and projects to arrive at their SBA grades.

(6) Student Performance

The National Evaluation and Testing Service (NETS) conduct three public examinations each year to measure student performance island-wide. The results are summarized below.

1) Results of Grade 5 Scholarship Examination

Table 2.2 gives the historical trend for the grade 5 scholarship examination.

Table 2.2 Grade 5 Scholarship Results

Year	No. Sat	No. of students qualified	% of students Qualified	No. of scholarships awarded	% of scholarships awarded
1999	256,139	25,889	10.1	9,924	3.9
2000	248,373	24,737	10.0	9,976	4.0
2001	274,656	24,414	8.9	9,987	3.6
2002	283,469	24,297	8.6	10,000	4.1
2003	292,483	23,205	7.9	10,000	4.3

Source: NETS Statistical Handbooks 1999, 1999-2001; R&D Branch, NETS (Department of Examinations), 2004

The figures show a very slim rate of success for candidates, being between 3.6% and 4.3%. Qualified students together with the scholarship winners are able to enroll in popular schools from grade 6. The number of students sitting the examination has increased while the number of students qualifying has decreased.

2) Results of GCE O-Level Examination

Table2.3 gives the historic trend for pass rates in six subjects from the O-Level curriculum – *mathematics*, '*science and technology'* and four other subjects for comparison.

Table 2.3 School Candidate Passes in GCE O-Level Examination

Subject	% Passes		
	2001	2002	2003
Mathematics	44.1	40.0	42.1
Science & Technology	53.9	54.6	49.0
Social Studies and History	76.1	78.0	77.0
History	65.2	52.1	80.2
Geography	57.0	50.7	62.7
Development Studies	81.3	70.1	88.2

Source: R&D Branch NETS (Department of Examinations), 2004

Note: Figures for the years 1999, 2000 are not comparable as both science and mathematics were examined with two papers of differing degrees of difficulty.

Pass rates in *mathematics* and *'science and technology'* are very low compared with the other four subjects. As well, from 2001 to 2003, there has been a decrease in the pass rate both for science and *mathematics* and '*science and technology'*.

3) Results of GCE A-Level Examination

Table 2.4 gives historic trend of pass rates for A-Level science stream subjects and three other A-Level subjects.

Table 2.4 GCE A-Level Examinations – Historic Trend Subject Results

Subject	Year					
	1999	2000	2001	2002	2003	2004
Biology	81.0%	79.0%	74.7%	71.3%	70.3%	75.5%
Chemistry	66.6%	66.9%	52.6%	50.1%	52.4%	50.5%
Physics	65.3%	63.1%	68.6%	62.4%	59.9%	59.4%
Combined Mathematics	49.0%	42.7%	52.2%	54.1%	55.6%	54.5%
Agriculture	70.8%	73.9%	77.3%	N/A	N/A	86.6%
Economics	61.6%	66.3%	67.1%	N/A	N/A	63.9%
Business Studies	71.2%	89.6%	93.7%	N/A	N/A	90.0%

Source: R&D Branch, NETS (Department of Examinations), 2004
Note: Less than 60% shaded

Pass rates of *chemistry*, *physics* and '*combined mathematics'* are low compared with *agriculture* and *business studies*.

4) Repetition and Dropout Rates

Repetition and Dropout Rates for Grades 3, 5, 9 and 10

Table 2.5 shows repetition and dropout rates of island-wide for grades 3, 5, 9 and 10 in 2001 and 2003.

Table 2.5 Repetition and Dropout Rates for Grades 3, 5, 9 and 10

Grades		Grade 3		Grade 5		Grade 9		Grade 10	
School Type		2001	2003	2001	2003	2001	2003	2001	2003
Repetition Rate %	Sinhala	0.7	0.3	1.3	0.6	0.5	0.5	0.4	0.2
	Tamil	3.1	1.9	4.2	2.2	1.6	1.6	1.5	1.4
	National	2.3	0.8	2.7	1.1	1.2	0.6	0.9	0.5
Dropout Rate %	Sinhala	0.1	0.2	0.5	3.7	5.1	4.4	5.1	4.9
	Tamil	-0.6	1.1	4.0	6.3	9.2	10.4	8.5	10.0
	National	-0.2	0.5	2.9	4.8	7.6	5.6	6.3	6.1

Source: School Census 2001, 2003, MOE
Note: Negative figures indicate growth in numbers.

Both the total repetition and dropout rates have generally improved between 2001 and 2003. Tamil speaking students still have both higher repetition and dropout rates than Sinhala speakers.

(7) School Facilities

1) Basic Infrastructure

The existing situation of basic infrastructure and school facilities was assessed using the results of the school survey[6] conducted by JICA Study team in 2003. Several school visits were also conducted during the course of

[6] School survey was conducted sampling 144 schools in total from all provinces and of all four different types of schools from January to February 2003.

the study. Both the survey and school visits showed that there is a wide gap between the official minimum standards and the condition of schools.

The school survey revealed that one third of rural schools and more than one half of plantation schools had no electricity. There were also many schools without telephones particularly Type 2 and Type 3 schools and 25% of these schools had no tap water. Rural and plantation schools were the most disadvantaged with basic infrastructure.

2) Facilities

Facilities for science and mathematics

Science rooms or multi-purpose rooms for grades 6 to 9 are single-storey structures with facilities for '*science and technology'* as well as for other technology skills. Nearly 80% of schools lack science rooms and have to use normal classrooms for science education. More than 50% of Type 2 and Type 3 school laboratories if they have one are in very bad condition.

O-Level science laboratories are single-storied structures with laboratory tables for students and a demonstration table for the teacher. There is a separate tiled worktop with two sinks of water and drainage, and two steel cupboards are available. Less than 40% of both urban and rural schools have O-Level laboratories, and 75% of those lack proper minimum facilities.

A-Level science laboratories are two-storied structures usually with separate physics and chemistry laboratories at ground level and biology laboratories at the upper level. There are two small adjoining rooms for storage and preparation. Except in the better urban schools, the general condition of the laboratories is poor. Maintenance is often poor, and most schools do not have a laboratory assistant.

2.2.2 Equitable Access to Quality Education

(1) Inequity in Urban and Rural

Many examples of inequities between urban and rural schools were found during school visits, school surveys and the Pilot Project. The greatest problem is an ongoing one - urban schools are getting bigger and rural schools are getting smaller. The gap is widening because wealthier parents observe the better pass rates and facilities in the 'popular' schools and have their children leave rural schools to attend a 'popular' school.

Rural schools have the following disadvantages compared with urban schools.

1) School management and community support

Many rural schools are small with poor leadership. Some principals are local political appointments who have had little or no training. They also lack administrative and financial management skills.

2) Available infrastructure and facilities

Many small rural schools do not have minimum infrastructure such as water supplies, electricity, telephones, separate classrooms and basic facilities like blackboards and chairs and tables.

3) Teachers' deployment

Politicization of teacher deployment is one of the factors with difficulties in attracting and keeping teachers in rural schools. This causes the teacher appointment, transfer and replacement system to be ineffective.

(2) Inequity in National and Provincial Schools

In Sri Lanka there are two categories of government schools. The majority of schools are provincial schools which are under respective Provincial Councils in accordance with the government decentralization policy endorsed in 1987. However, there are currently 323 national schools which enjoy special status and which are directly administered by MOE. Table 2.6 shows the number of schools, students and teachers in national and provincial schools.

Table 2.6 Number of Schools, Students and Teachers

Schools	No. of Students	No. of teachers	No. of school				
			Type1AB	Type 1C	Type 2	Type 3	Total
National School	688,739 (17%)	27,626 (15%)	284 (88%)	38 (12%)	1 (0%)	0 (0%)	323 (100%)
Provincial School	3,252,946 (83%)	159,069 (85%)	322 (3%)	1,715 (18%)	4,266 (45%)	3,164 (33%)	9,467 (100%)
Total	3,941,685 (100%)	186,695 (100%)	606 (6%)	1,753 (18%)	4,267 (44%)	3,164 (32%)	9,790 (100%)

Source: School Census 2003

The following are some issues concerning inequities between national and provincial schools:

1) Teacher Deployment

National schools attract more qualified teachers because of their congenial or very congenial locations and better facilities as well as higher social status that national schools emit.

2) Financial Resources

Financially national schools and provincial schools are managed differently, the former directly by MOE and the latter through provincial government. In addition to Quality Input Funds, which all government schools receive based

on a defined formula, national schools receive extra government funds for library books, minor repairs, etc. Provincial schools do not have regular allocation of such funds.

3) School Facilities

Majority of National Schools are located in urban areas and have good infrastructure and facilities. On the other hand many of the provincial schools are small-scale Type 2 and Type 3 schools located in rural areas. From the observation, in general, many schools lack necessary infrastructure such as portable water supply and toilet facilities, and school buildings are not in good condition with insufficient minimum facilities.

(3) Inequity in Medium of Instruction

Several Donors have made quality interventions in the North East Province conflict areas and Tamil plantations areas with building programs, teacher training, school education and assisting with trauma affected students and these are having a positive effect. However, there are still inequities between the quality of education using the Sinhala and Tamil mediums of instruction.

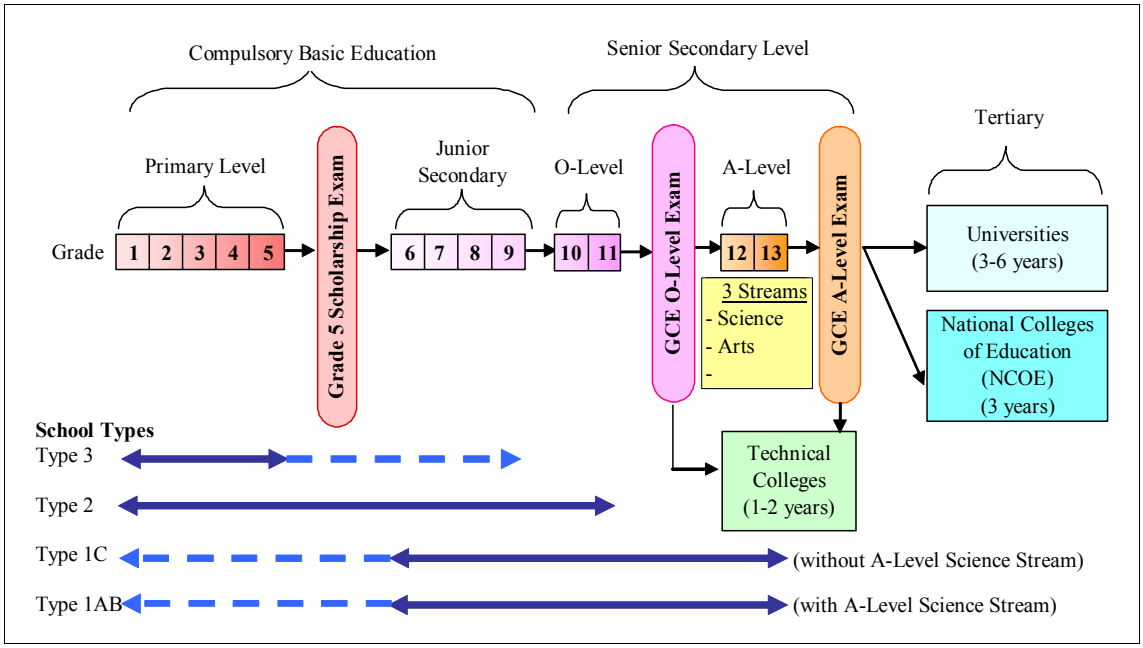
2.2.3 Planning and Management

(1) Education System

Sri Lanka's education system consists of 5-year primary level (grades 1 to 5), 4 year junior secondary level (grades 6 to 9), and 4-year senior secondary level (grades 10 to 11 called as O-Level and grades 12 to 13 called as A-Level), as illustrated in Figure 2.1. The first 9 years are considered as compulsory basic education. Education in Sri Lanka is predominantly implemented by the state sector, and all education in government schools, from primary to tertiary, is free of charge.

Schools are classified into 4 types: Type 1AB school with class up to grade 13 including A-Level science stream; Type 1C school with class up to grade 13 without A-Level science stream; Type 2 school with class up to grade 11; and Type 3 school with class up to grade 5 (or grade 9 in some cases).

There are 10,475 schools in Sri Lanka as of 2003, out of which 9,790 (93%) are government schools, 85 (1%) are private schools, and 600 (6%) are pirivenas, that is, schools for *bhikkus* (Buddhist monks), for which MOE pays salaries for teachers and other expenses.



Source: MOE

Figure 2.1 School System of Sri Lanka

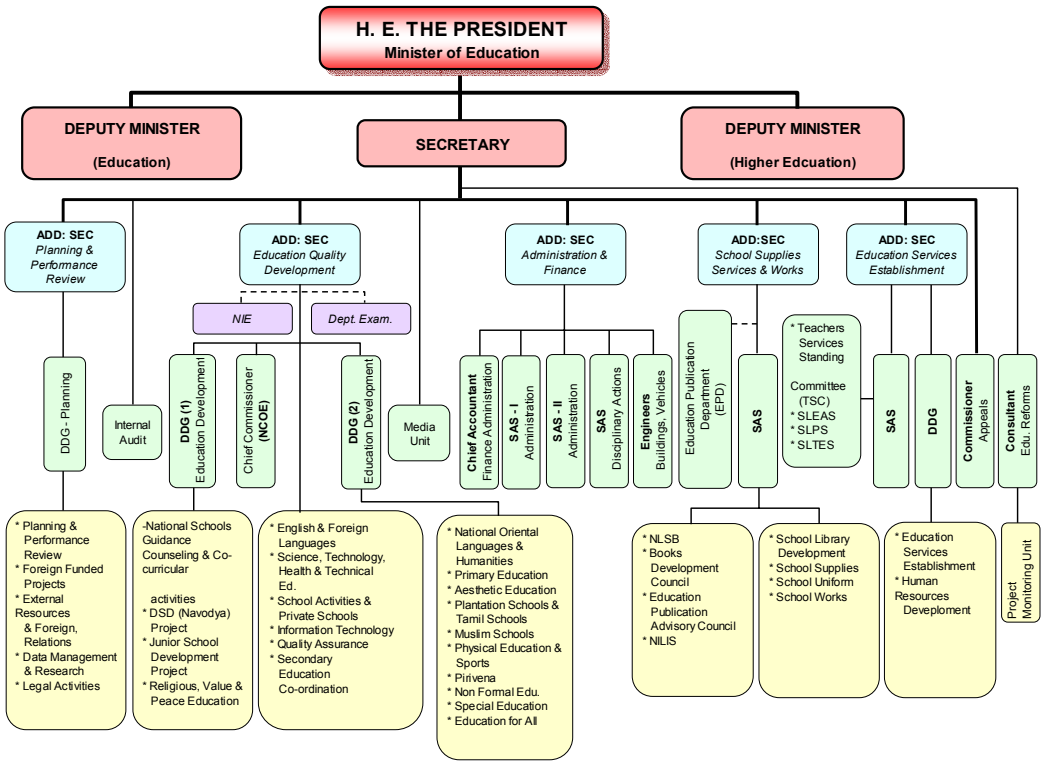
(2) Administrative Structure and Management

1) Organization of MOE and Administration

In April 2004 the newly elected government restructured the Ministry of Education (MOE) to be wholly responsible for the education sector from primary education to tertiary education including universities, by integrating previously separate three Ministries, namely the Ministry of Human Resource Development, Education and Cultural Affairs, the Ministry of School Education and the Ministry of Tertiary Education and Training.

In the current devolved education administrative system, MOE's main functions are in policy, planning, programming, supervision and management. The general education sector of MOE consists of five main divisions: Policy Planning & Performance Review, Education Quality Development, Human Resources Development of Education Services, Administration and Finance, and Supplies. Under each division are several branches and units as shown in Figure 2.2.

Although most of the government schools are administered by the Provincial Councils, there are a small number of national schools which come directly under MOE.



Note: ADDSEC: Additional Secretary, DDG: Deputy Director General, NIE: National Institute of Education, SAS: Senior Assistant Secretary, SLEAS: Sri Lanka Educational Administrative Service, SLPS: Sri Lanka Principals' Service, SLTES: Sri Lanka Teacher Educators' Service, NSLB: National School Library Board, NILIS: National Institute of Library Information System

Source: MOE

Figure 2.2 Organizational Structure of MOE General Education Sector

2) Organization of National-level Education Institutions

a) National Education Commission (NEC)

NEC established in 1991 is a statutory body appointed by the President. NEC is responsible for the formulation of education policy for all sectors of the education system. In addition, they periodically review and analyze the national education policies and plans. In December 2003, NEC presented a set of policy proposals following a comprehensive review on General Education Reform introduced in 1997.

b) National Institute of Education (NIE)

NIE, established as a semi-autonomous institution in 1986, now has over 500 personnel. NIE has been currently restructuring under the new Director General.

NIE is responsible for the design, review and revision of the school curriculum, production of syllabuses and teacher's guides for all subjects in the curriculum and in-service training in the use of such material for the subjects. NIE is also concerned with the on-going education of principals and

teachers on education management. NIE also provides academic research and library and information services for educational development, school-based initiatives and advice for the Ministry.

c) National Evaluation and Testing Service Institute (NETS)

The main function of NETS is the conduct and control of the three public examinations island-wide. These are the grade 5 Scholarship examination, GCE O-Level Examination and GCE A-Level Examination. Under the 1997 Reforms, NETS also administers SBA procedures for O-Level and is developing SBA for A-Level.

(3) Teacher Training and Deployment

1) Teacher Training

In 1997, MOE established the National Authority on Teacher Education (NATE) to co-ordinate and control teacher education undertaken by various institutions. NATE drafted a new National Teacher Education Policy in 2001, which describes a new qualification for teachers in primary and secondary levels, as shown in Table 2.7.

Table 2.7 Qualification for Teachers in Each Level

Level	Required qualification for teachers
Primary (grade 1 to 5)	- National Diploma in Teaching on primary education from National Colleges of Education (NCOE), or - Trained Teachers' Certificate on primary education from Teachers' (Training) Colleges (TTC)
Junior Secondary /O-Level (grade 6 to 11)	- National Diploma in Teaching on specific subjects from National Colleges of Education (NCOE), - Trained Teachers' Certificate on specific subjects from Teachers' (Training) Colleges (TTC), or - University graduates with professional teaching qualifications
A-Level (grade 12 to 13)	- University graduates with professional teaching qualifications, or - Those with accredited qualifications equivalent to university degrees from teacher education institutions such as NIE

Source: National Teacher Education Policy (National Authority on Teacher Education, MOE, 2001

Based on this policy, the new teachers for grades 1 to 11 are basically recruited from National Colleges of Education (NCOE), which offer 2-year residential program and 1-year internship at the school. Science and mathematics teachers for A-Level class are recruited from university graduates, and most of them are Science graduates. It has been observed that many of them have no professional education before they start to teach.

More than 90% of NCOE students are female, because female students get higher marks in A-Level Examination than male students. Since already about 70% of teachers are female, the higher percentage of female NCOE students will certainly increase the share of female teachers further in near future, which may have negative implications on solving unequal distribution of teachers between urban and rural areas, because many female teachers prefer or are obliged to work in urban areas due to family reasons.

Since initial teacher education has been improved significantly in recent years, continuing teacher education is the next agenda for MOE. A total of 100 Teacher Centers have been established nationwide for short-term in-service training (mainly conducting half- to 2-day workshops during weekends), 16 of which were recently constructed under the IBRD's Teacher Education and Teacher Deployment Project (TETD). Every Teacher Center is attached to one NCOE, which dispatches lecturers for seminars and workshops in the affiliated Teacher Centers.

However, the opportunities for continuing education at Teacher Centers and TEI are still limited, and the contents of continuous training needs to be developed.

2) In-Service Advisers (ISA)

There are 2,507 subject-wise In–Service Advisers (ISAs), also called as Master Teachers in Sri Lanka, who are attached to Divisional Education Offices. ISAs have two roles: 1) to train teachers on the new curriculum introduced by NIE through seminars, and 2) to visit government schools regularly, observe the teaching and learning process in classrooms, and advise teachers (except A-Level teachers) on how to improve their teaching. Lack of ISAs for A-Level (grades 12 and 13) teachers is considered as weakness in teacher support in A-Level.

There is a very unequal distribution of ISAs among provinces as well as between Sinhala and Tamil medium schools. Out of 2,507 ISAs, 571 (23%) are Tamil-medium ISAs. ISAs for science and mathematics are generally in shortage, except Sinhala-medium ISAs in Western, Southern and Uva Provinces and Tamil-medium ISAs in North Western Province.

3) Teacher Deployment

National Teacher Education Policy in 2001 specifies that teacher supply should be based on the standard student-teacher ratios (26:1 for primary level and 22:1 for secondary level). Based on this student-teacher ratio, there is large excess of teachers in Type 2 and Type 3 Sinhala-medium schools, but there is shortage of teachers in Type 1AB Sinhala-medium schools and Type 1AB, Type 1C and Type 2 Tamil-medium schools.

Teacher shortage is generally more acute in Tamil-medium schools than Sinhala-medium schools. It is also well known that rural schools suffer most from shortage of teachers, because many teachers feel difficult to commute to remote rural schools without teachers' quarters, and many married teachers prefer to work in urban centers where their children can attend urban popular schools.

While there are government policy and regulations to try to solve teacher shortage in rural schools, the real problem is that MOE has never implemented them strictly, so there are many cases of exceptions where teachers were able to escape from the duties to work for rural schools reportedly by using local politician's influence.

(4) Finance for Education

In Sri Lanka, all education from primary school to university is financed by the government. Table 2.8 shows the trend of government expenditures and education expenditures for the last two decades.

Table 2.8 Government Expenditures on Education (Rs. billion)

	1980	1985	1990	1995	1996	1997	1998	1999	2000	2001	2002*
Government Total Expendirute											
Recurrent	13.46	32.65	71.77	154.16	175.15	184.75	199.65	207.27	254.28	303.36	330.27
	52.8%	60.3%	78.6%	78.7%	82.3%	80.8%	78.7%	77.5%	79.0%	81.7%	84.9%
Capital	12.03	21.53	19.53	41.72	37.64	43.98	54.16	60.34	67.77	67.90	58.59
	47.2%	39.7%	21.4%	21.3%	17.7%	19.2%	21.3%	22.5%	21.0%	18.3%	15.1%
Total	25.49	54.18	91.30	195.88	212.79	228.73	253.81	267.61	322.05	371.26	388.86
Education Expenditure											
Recurrent	1.54	3.53	8.54	16.97	18.83	20.10	22.61	22.49	26.08	32.04	35.24
	85.6%	84.4%	88.0%	83.1%	80.6%	79.6%	77.3%	74.9%	80.5%	85.3%	88.4%
Capital	0.26	0.65	1.16	3.45	4.53	5.15	6.63	7.55	6.30	5.53	4.61
	14.4%	15.6%	12.0%	16.9%	19.4%	20.4%	22.7%	25.1%	19.5%	14.7%	11.6%
Total	1.80	4.18	9.70	20.42	23.36	25.25	29.24	30.04	32.38	37.57	39.85
General Education Expenditure											
Recurrent	1.40	3.18	7.58	14.69	16.35	16.15	19.00	18.85	23.13	27.10	30.02
	92.1%	91.9%	91.2%	83.9%	82.0%	80.9%	78.8%	75.2%	82.7%	86.9%	89.5%
Capital	0.12	0.28	0.73	2.81	3.58	3.81	5.11	6.20	4.84	4.09	3.51
	7.9%	8.1%	8.8%	16.1%	18.0%	19.1%	21.2%	24.8%	17.3%	13.1%	10.5%
Total	1.52	3.46	8.31	17.50	19.93	19.96	24.11	25.05	27.97	31.19	33.53
(Higher Education Expenditure)											
Recurrent	0.14	0.35	0.96	2.28	2.47	3.96	3.61	3.64	3.95	4.94	5.21
Capital	0.14	0.38	0.42	0.63	0.96	1.33	1.52	1.35	1.46	1.44	1.10
Total	0.28	0.73	1.38	2.91	3.43	5.29	5.13	4.99	5.41	6.38	6.31
Education Expenditure as % of Total Government Expenditure											
	7.06%	7.72%	10.62%	10.42%	10.98%	11.04%	11.52%	11.23%	10.05%	10.12%	10.25%
Recurrent Education Expenditure as % of Total Government Recurrent Education Expenditure											
	11.44%	10.81%	11.90%	11.01%	10.75%	10.88%	11.32%	10.85%	10.26%	10.56%	10.67%
Capital Education Expenditure as % of Total Government Capital Expenditure											
	2.16%	3.02%	5.94%	8.27%	12.04%	11.71%	12.24%	12.51%	9.30%	8.14%	7.87%
Education Expenditure as % of GDP											
			2.20%	3.11%	3.06%	2.90%	2.98%	3.07%	2.89%	3.06%	2.81%

Source: Sri Lanka University Statistics 2003, University Grants Commission

Note: Data for 2002 is provisional

In recent years, the government education expenditure has hovered at around 3% of GDP, lower than the 3.5% mean for Asia and the 3.9% mean for developing countries. Similarly, the share of education in the total expenditures was remained at around 10%, below the 14% mean for Asia and 15% for developing countries.

Another characteristic of Sri Lanka's education expenditures is the low capital expenditures. Continuous recruitment of large number of teachers in the late 1980's and early 1990's and salary hike in 2000 contributed to large increases of recurrent expenditure.

(5) School Management

School-Based Management (SBM) being recognized as a key strategy to improve schools in General Education Reform was introduced in 1997 and a need of introduction of SBM was further reiterated in the Proposals for National Policy Framework on General Education (2003). However, until recently no clear policy decision was taken to accelerate the move towards SBM. Therefore, although a number of measures were introduced to schools either as a pilot or on a regular basis, which have supported move towards more autonomy at school level, management system and school culture still remained top-down and bureaucratic.

Since July/August 2004, MOE has been initiating a number of discussions on the issue of SBM with various stakeholders. The government now has a pilot plan of implementing SBM in 16 zones[7] starting from early 2005. From 2006 some financial responsibilities will be transferred to schools island-wide under Education Sector Development Program (2006-2010) under SWAp. However, details of devolution to schools under SBM are not yet determined.

Current situation of school management in personnel, curriculum, and financial management are explained below.

1) Leadership of Principals and Personnel Management

Principals play a very important role in improving quality and efficiency of education in school and NIE conducts management training for principals, both full-time and part-time basis.

Through the implementation of JICA Pilot Project it is also identified that the facilitative leadership is one of the most important qualities to succeed in school-based activities. Though some principals were excellent in bringing consented decision and building team work among teachers and parents, others lacked leadership or resorted to dictatorial command system. Capacity

[7] In addition to schools in 16 selected Zones, all National Schools and Navodya Schools will take part in the project.

building of principals and senior teachers in management skills, including leadership training, should be further emphasized.

2) Curriculum Development

All government schools follow the national curriculum, and text books are centrally managed and distributed to schools. In reality, however, apart from primary level, it is rare to find innovative teaching methods in school situation. Teachers rigidly follow teacher's guides and little initiative is taken to make the class more interesting and meaningful. This is also partly due to the fact that secondary level education focuses too narrowly on national exams.

c) Financial Management

At school level the main source of funding is from the government. Teachers' salaries are sent to the school account by the government. Utility costs, such as electricity, water and telephone, are paid partly by the government and partly by the school.

In the year 2000 under the IBRD funded GEP2, Quality Inputs Fund was introduced to schools, which allows schools to purchase quality input items within the prescribed regulations. This funding system has been widely appreciated by the principals and teachers as schools are able to obtain what they need for the school in accordance with their own priorities. This scheme has been carried over by the government after the fund allocation under GEP2 ended in 2003.

CHAPTER III

THE PILOT PROJECT

3.1 Design of the Pilot Project

3.1.1 Background and Objectives

(1) Background

In reviewing the government strategy and programs in the education sector, it was revealed that the education sector in Sri Lanka has been operating in a bureaucratic and top-down administrative structure for many years. Accordingly, schools have been following the instructions given by MOE for the development of school management, education and basic infrastructure and facilities.

In order to analyze the accomplishment in the education sector, particularly in science and mathematics education, achieved by intervention of the government, a considerable number of school visits and interviews to principals were conducted and various problems were identified including low motivation of teachers, limited cooperation with parents and community, and little progress in teaching and learning method. Consequently, schools have not been a pleasant place for students and they have become less interested in learning, particularly science and mathematics.

In addition, the school survey was conducted to further understand the current situation in the education sector. The survey clarified a wide range of constraints in school management, quality education and basic infrastructure and facilities at schools, in particular, a disparity in educational conditions between urban and rural areas. However, it was also identified that some schools are trying to improve quality of education and school management through active participation of parents and community and these schools tend to have high academic achievement. This survey showed that the school-based approach would be quite effective in improving the quality of education and should be further developed.

Taking this survey results into account, the Pilot Project was formulated by applying the school-based approach or Educational Kaizen activities to the 25 pilot schools. The challenge focused on changing school culture as a prerequisite for the development of school management, science and mathematics education and basic infrastructure and facilities.

(2) Objectives

The objectives for implementing the Pilot Project were:

- To identify and apply the school-based activities for improvement to the selected schools;
- To assess outcomes and their sustainability; and
- To incorporate results of the Pilot Project into the Master Plan.

3.1.2 Concept and Flow

(1) Concept

The basic concept of the Pilot Project was to apply school-based approach or Educational Kaizen activities to the education sector. The Kaizen strategy is the most important concept in Japanese management, and is well known as one of the key factors for successful competitiveness in Japanese companies. Kaizen means continuous improvement involving everyone; top management, managers and workers. It was originally developed in the manufacturing sector, but now is applied in many sectors and in many countries. Kaizen activities include various methodologies of participatory approach such as 5S[8], suggestion system and Quality Control (QC) circle.

The Pilot Project utilized the Educational Kaizen concept in order for schools to improve school management, quality of science and mathematics education and basic infrastructure/facilities.

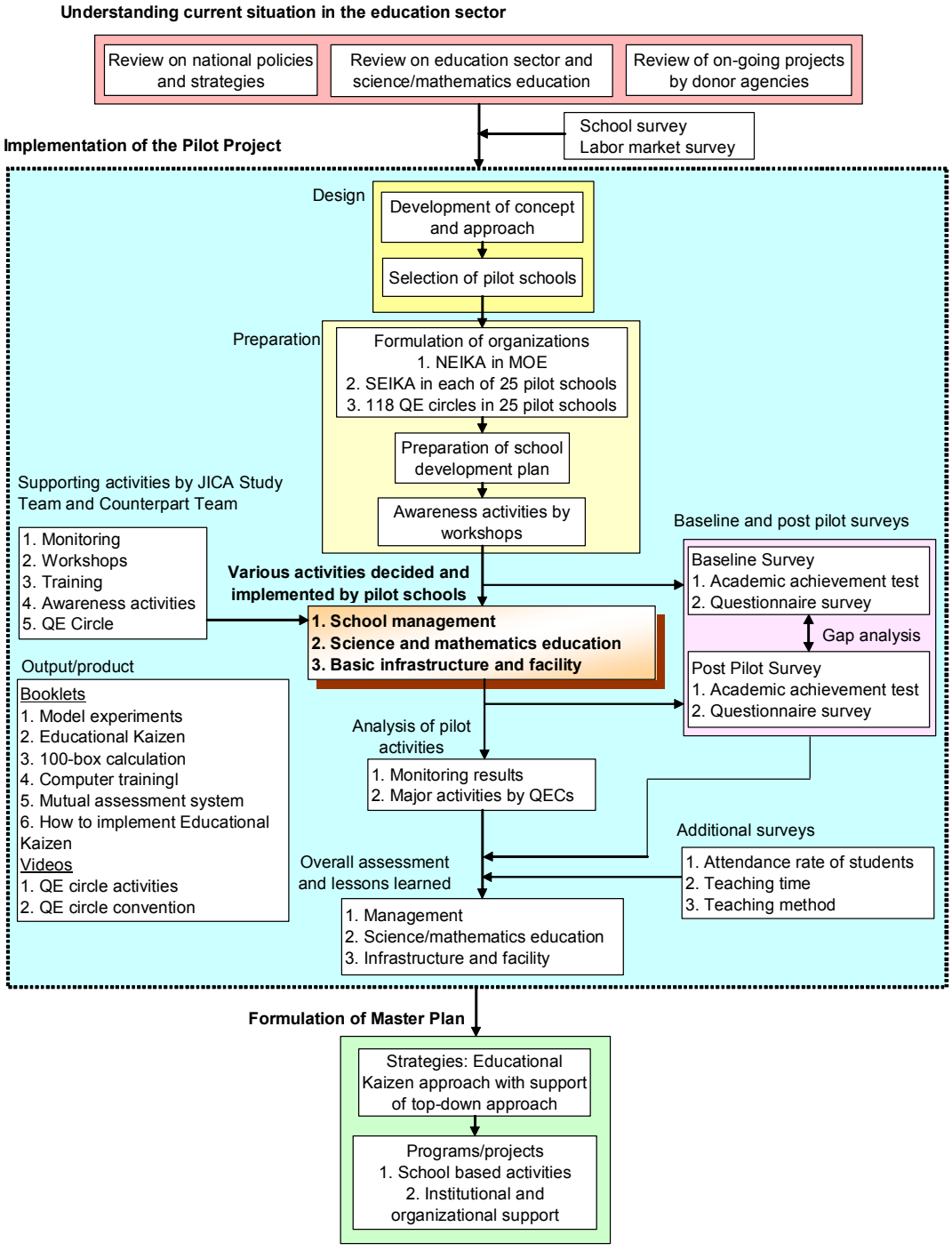
(2) Flow of the Pilot Project Implementation

The overall flow in implementing the Pilot Project is illustrated in Figure 3.1.

Following a review of the current situation, national policies and strategies and ongoing donor projects, the Pilot Project was designed to prove that a school-based approach strategy will improve the quality of science and mathematics.

In order to assess the impact of the Pilot Project, the Baseline Survey and Post Pilot Survey were conducted before and after the Pilot Project respectively. Through implementation of the Pilot Project, various outputs in the forms of booklets and video films were developed for the dissemination of Educational Kaizen activities to all schools. The outcomes from the Pilot Project were incorporated in the Master Plan, based on the overall assessment of the Pilot Project and lessons learned.

[8] 5S originated in Japan and stands for five systematic steps of the process, that are SEIRI (Classify), SEITON (Clear), SEISOU (Clean), SEIKETSU (Continue), and SHITSUKE (Commitment). 5S aims to create a highly productive working environment.



Source: JICA Study Team

Figure 3.1 Overall Flow of the Pilot Project Implementation

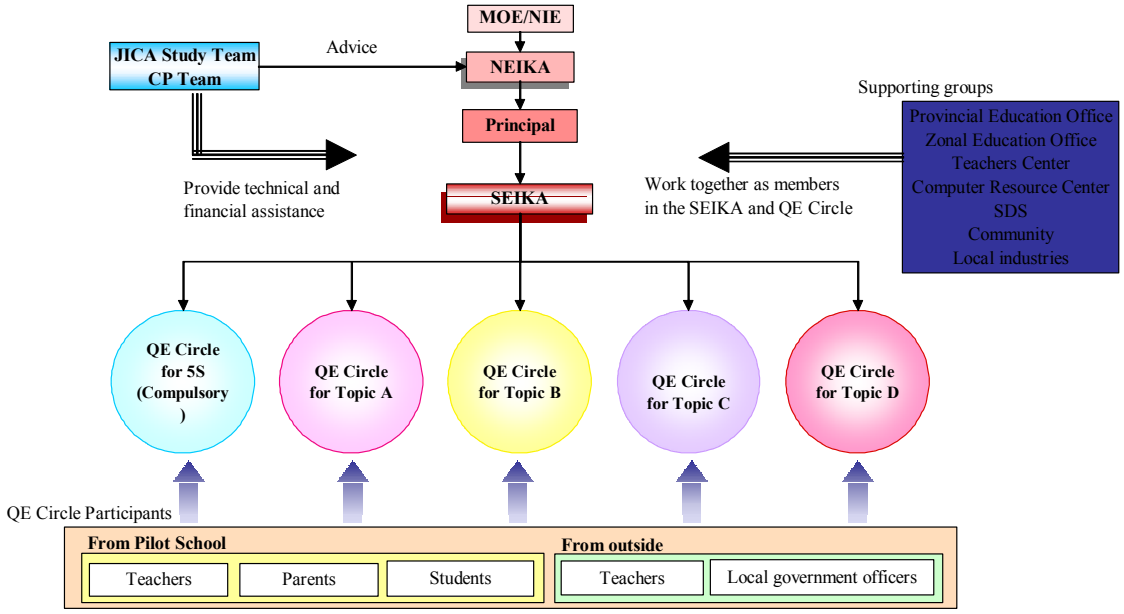
3.1.3 Selection of Pilot Schools

The 25 pilot schools were selected based on joint evaluation of proposals by MOE, NIE and JICA Study Team. The evaluation criteria of those proposals were: 1) impact on quality of education in science and mathematics; 2) impact on school management; 3) past efforts using a participatory approach; 4) proper

selection of Educational Kaizen topics; 5) clear plan of proposed Educational Kaizen activities; and 6) the extent of community participation. Since educational environment varies among schools by province, school type and location, pilot schools were selected to cover those various educational environments.

3.2 Overall Implementation Structure

Proposed overall implementation structure for the Pilot Project is as illustrated in Figure 3.2. The National Educational Initiative of Kaizen Activities (NEIKA) was established as a supervisory body in implementing the Pilot Project. The objectives of NEIKA are to plan, to implement, to monitor and to evaluate the Pilot Project at the national level. In implementing the Pilot Project, a joint team consisting of NEIKA and the JICA Study Team was responsible for the selection of pilot schools and approval of the Educational Kaizen topics. The members consisted of 1) Additional Secretary of MOE, 2) Director General of NIE, 3) representatives of provincial offices, pilot schools and the Counterpart Team, and 4) representatives of the private sector. NEIKA meetings were held monthly.



Source: JICA Study Team

Figure 3.2 Implementation Organization

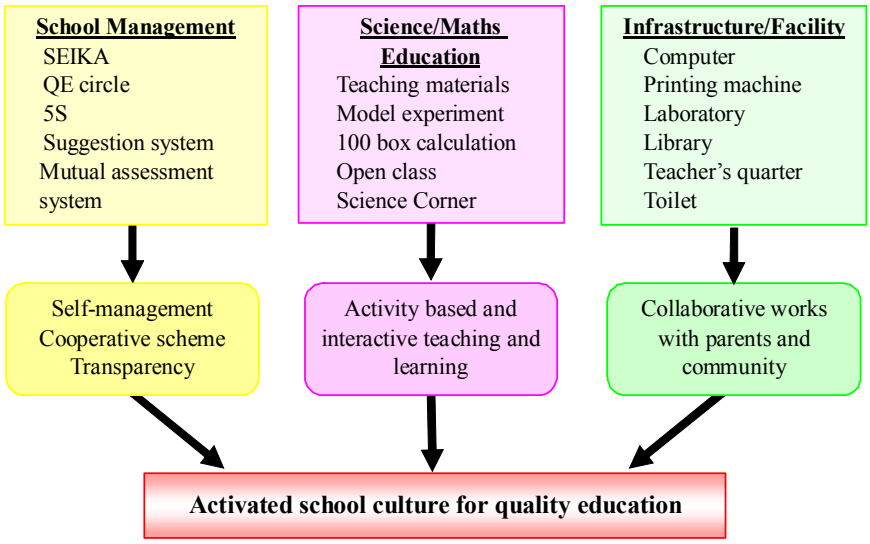
Under NEIKA, each pilot school formed a School Educational Initiative of Kaizen Activities (SEIKA) with the objectives of planning, implementing, monitoring and evaluating the Educational Kaizen activities at the school level. SEIKA was responsible for selection of Educational Kaizen topics, formation of QE circles, budget proposal, procurement, preparation of progress reports and financial reports. Members of SEIKA consisted of 1) the principal, 2) director of education in science and mathematics in zonal education office, 3) In-Service

Advisors in science and mathematics, 4) head teachers in science and mathematics, 5) representatives of SDS, 6) representatives of parents and so on. In order to maintain transparency in implementing the Pilot Project, involvement of representatives from outside the school was mandatory. SEIKA meetings were held about twice a month.

3.3 Major Activities by QE Circles

(1) QE Circle Activities

118 QE circles were formed at 25 pilot schools. The number of activities implemented by the 118 QE circles was 944.[9] On average, each QE circle executed around eight activities for the one-year project period. These activities were classified into three major groups, namely (i) improvement of school management, (ii) improvement of science and mathematics education, and (iii) improvement of basic infrastructure and facility. The overview of QE circle activities is illustrated in Figure 3.3.



Source: JICA Study Team

Figure 3.3 Overview of QE Circle Activities

3.4 Supporting Activities for the Pilot Schools

3.4.1 Monitoring

The monitoring team, consisting of members from the JICA Study Team and the Counterpart Team visited all pilot schools for seven times during the period of the Pilot Project.

The objectives of the monitoring activities are:

- To evaluate progresses of activities of QE circles

[9] Actual number of activities is larger than the figure mentioned here, since this indicates only major activities selected by the pilot schools.

- To assist SEIKA and QE circle members in solving problems and constraints in implementing Educational Kaizen activities
- To assist in preparing monthly reports
- To monitor expenditure of SEIKA and QE circles for the Pilot Project

The monitoring team evaluated performance of the pilot schools through discussions with members of SEIKA and QE circles, interviews with teachers, students and parents as well as observation of classrooms.

3.4.2 Workshop, Training, Awareness Activities and QE Circle Convention

The various workshops, training and awareness activities were conducted to support and encourage Educational Kaizen activities of QE circles. Those are Intermediate Workshops, Model Experiment Workshops, Regional Workshops, School-based Workshops, Computer Training Program, Website, Newsletter and Poster.

As the final event of the Pilot Project, the QE Circle Convention was held for three days in August 2004, inviting representatives of the 25 pilot schools, provincial and zonal offices and MOE/NIE officials. All 118 QE circles made presentations in seven parallel sessions. Also there was an exhibition, where the pilot schools demonstrated their outputs developed through the Pilot Project.

3.4.3 Model Experiments

In order to accelerate promotion of activity-based and interactive teaching and learning methods, 36 model experiments were developed by JICA Study Team, Counterpart Team and teachers of the pilot schools. Trainings in implementing these model experiments were conducted for selected teachers of the pilot schools at NIE, followed by the school-based model experiment workshops at each pilot school. The instruction manuals of 36 topics were revised through these trainings and

workshops and finalized as shown in Appendix: Guideline of Model Experiments. The titles of the selected model experiments are listed in Table 3.1.

Table 3.1 List of Model Experiments

	No	Title	Grade
ERA	1	Can we forecast out future growth rate by using present data?	1-5
	2	Friends we meet in our environment	2
	3	How rockets operate? - understanding the principle behind rocket movements	3
	4	Let's build a model to show lighting	3
	5	Observing the behavioral pattern of an insect	3-5
	6	Observe How a Volcano Erupts	4
	7	How we identify our body parts?	4
	8	Desires of an earthworm towards light	4-5
	9	How a Tornado occurs?	4-5
	10	Fruits & vegetables also can be used as electric cells	5
	11	Which bridge type is stronger?	5
Primary Maths	1	Measurement of the human body	2
	2	Let us count from 1 to 50	2
	3	Let us draw our school map	4
	4	Number bonds using dominos	4
	5	Space management in the Classroom	4
	6	Estimating the height of objects which cannot be easily measured	5
	7	Drawing the path to my school from home	5
	8	Pattern in changing height	5
	9	Estimate the number of letters in a book	5
	10	Let's keep our school environment clean	5
Junior Secondary Science	1	Magnetic lines of force made visible	6
	2	Let's learn to make electricity circuits	7
	3	Reflection and refraction in reality	7
	4	Can heat make a balloon move?	8
	5	Does a generator suffer fatigue?	8
	6	A motor made within five minutes	9
	7	Can we use water to burn a paper?	10-11
	8	Can floating objects exert weight?	13

	No	Title	Grade
Junior Secondary Mathematics	1	Let's find a place for the lamp stand	8
	2	Can you locate the treasure?	8
	3	Let's estimate construction cost for a school building	8
	4	How to reduce your consumption of scarce water in order to save the earth	9-11
	5	Profitability of transportation industries	10-11
	6	Getting ready for inter house sports meet	10-11
	7	The shortest path: science giving solutions to mathematical problems	10-11

Source: JICA Study Team

3.5 Analysis of the Pilot Project

After one year operation of the Pilot Project, evaluation and analysis were carried out through the monitoring survey and port pilot survey.

3.5.1 Analysis of Monitoring Results

Based on the performance evaluation obtained through the monitoring activities, the pilot schools were divided into three groups according to the overall performances and processes of improvement, that is, 1) stable performance, 2) rising performance and 3) stagnant performance, as shown in Figures 3.4.

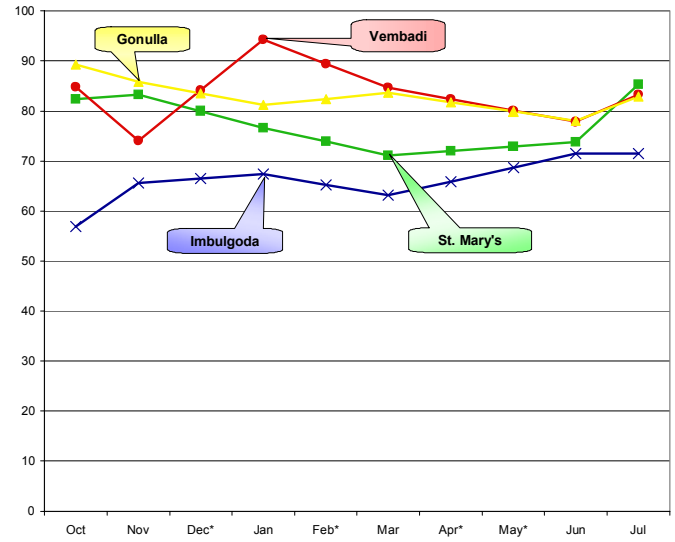
(1) Overall Analysis

Most of the pilot schools successfully implemented the Pilot Project, based on the school development plan that they themselves had prepared. This proves that Educational Kaizen approach can be applied to various schools including small and poorly-equipped rural schools[10].

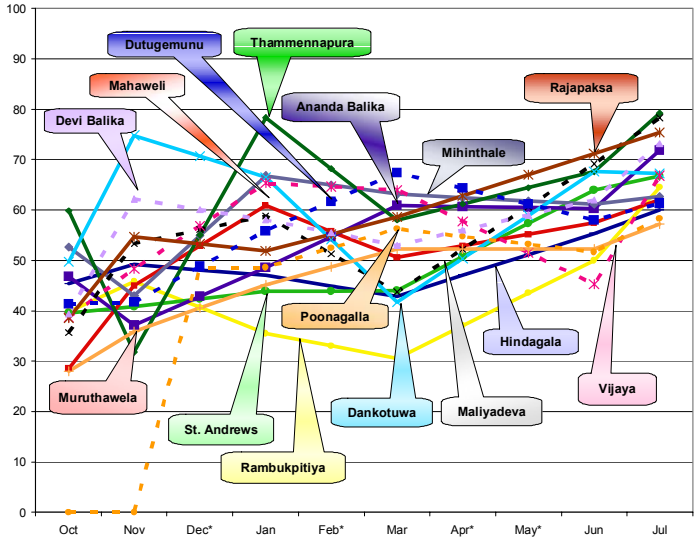
Improvement of Educational Kaizen activities varied among the pilot schools, but it did not depend on academic level, school type, location and size.

The key success factor was the facilitative leadership of the principal. Where the principal was authoritative, the schools faced difficulties in achieving an improvement through Educational Kaizen approach due to the limited and inadequate communication between the principal, teachers, parents and the community.

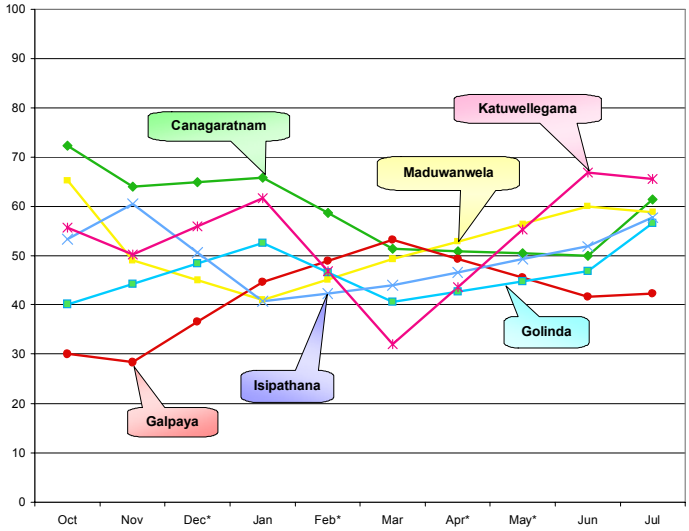
[10] The best school awarded at QEC Convention was given to Gonulla Kanishta Vidyalaya, a small rural school without sufficient facilities.



(1) Stable Performance



(2) Rising Performance



(3) Stagnant Performance

Note: Y-axis is an evaluation scale of monitoring results (max=100 point). X-axis is a time scale in 2003 to 2004.
Source: JICA Study Team

Figure 3.4 Progress of Educational Kaizen Activities at the Pilot Schools

When the principal was activated and facilitative, various constraints such as lack of communication, team spirit and transparency were eliminated and participation of parents and community gradually increased.

In case when the capability of the principal was deemed not suitable for managing the Educational Kaizen activities, an activated teacher should be assigned the role of project coordinator to enhance the school management. However, when the principal was totally authoritative and/or not activated, even the efforts of capable coordinator and activated teachers could not lead to the expected results.

Quality of education could not be improved without an activated school culture. Having successfully achieved a change in the school culture, the pilot schools further strengthened their Educational Kaizen activities.

(2) Stable Performance Group

The reasons why these pilot schools could achieve the stable performance level during the Pilot Project can be summarizes below:

- The principal understood the concept of Educational Kaizen activities well from the beginning and recognized the benefits.
- The principal was a good facilitative leader.
- Because of the proper understanding of the concept, the most suitable teachers were assigned as the project coordinator and QEC leaders.
- St. Mary's College and Vembadi Girls' High School are among the leading schools in the area and had capable and motivated teachers. As the collaborative working culture was introduced through the Pilot Project, their performance was further enhanced.
- Gonulla K.V. and Imbulgoda Sunethradevi K.V. are small Type 3 schools located in rural areas and have limited human resources. However, the principals of these schools were activated and had clear vision to improve the school. Because of the small size of schools, it was relatively easy to make teachers understand the concept and benefits. In addition, the schools' close relationship with the community enabled a high level of parent participation.

(3) Rising Performance Group

The reasons why these pilot schools could raise their performance through the Pilot Project can be summarized below:

- It took time for the principal to properly understand the concept of Educational Kaizen and recognize its benefits.
- In most cases, the school culture gradually changed through various interventions of the Pilot Project. Some of the contributing factors

includes: 1) Problems were solved on site through discussion with the monitoring team; 2) Real communication was brought about through mutual assessment system; 3) Collaborative relationship grew up among teachers through open class system; and 4) Opportunities were given to exchange ideas and information among the pilot schools through a number of workshops as well as visits to other pilot schools.

- Most of these schools became confident especially after the school-based workshops, by seeing appreciation and satisfaction of participants from neighboring schools.

(4) Stagnant Performance Group

The reasons why these pilot schools could not accomplish successful results can be summarized below:

- Some of the principals in this group could not fully understand the concept and benefit of Educational Kaizen approach until the end.
- They thought that 5S was just cleaning and improving the physical appearance. They tried to "entertain" the monitoring team by showing the improvement in the environment, but did not go beyond that.
- In Isipathana College, the large school size made it difficult for the newly appointed principal to change school culture, since quite a number of older teachers showed resistance against a change.

3.5.2 Analysis of QE Circle Activities

(1) School Management

Principal and teachers tend to work individually in schools. Communication practice is rather limited and information is shared only among a small number of staff members. No critical issues are discussed at staff meetings and no decisions are made. Consequently, there is no school culture to make them activated and cooperate with each other. Although a considerable amount of inputs such as training, equipment supply, infrastructure development have been undertaken for schools through various projects in the past, outcome could not be at a satisfactory level under this situation. This was a real situation in most of the pilot schools.

The Pilot Project challenged this most fundamental but complicated task, applying Educational Kaizen approach. In all pilot schools, the school culture started to change, through which (i) teachers became activated, (ii) teachers started to work together, (iii) teachers started to pay more attention to students, (iv) teachers started to think and act by themselves, and (v) parents started to participate in school activities. Although it was a time consuming and difficult process, the pilot schools started to move forward. Eventually, teachers noticed

that they can solve most of their problems through team work, and their experience of problem solving made them confident, activated and happy.

Based on the overall experience of the Pilot Project, it can be said that schools should start with 5S activities and mutual assessment system in order to develop the foundation for Educational Kaizen activities.

(2) Science and Mathematics Education

Teachers heavily depend on the teachers' guides supplied by MOE and expect to gain new ideas only by participating in training and seminars that the principal assign them to attend. They seldom study on their own to collect the latest information related to science and mathematics and rarely develop their original teaching method and teaching materials. Activity based and interactive teaching and learning is not a very popular method among teachers, since they are not so confident in its practice. As a result, their teaching method remains conventional and students lose interest in science and mathematics. Moreover, teachers do not find it joyful to teach, and leave school to go home at 2 p.m. sharp. This was the typical working attitude of many teachers in the pilot schools.

Recognizing that improvement in the quality of education in science and mathematics is not possible without changing teachers' attitudes, the Pilot Project challenged them to promote self-learning activities through Educational Kaizen approach. Through QE circle activities, teachers learned to think, plan and develop teaching materials and activity based and interactive teaching and learning. The open class system made teachers more confident in their teaching skills. 100-box calculation proved to be an effective tool to strengthen the basic calculation skills.

As a result, teachers understood that they could improve their teaching skills by self-learning to a large extent, when they worked together and taught each other. In addition, they recognized that teaching is a joyful work. Although it will take more time to ensure changes, things started moving forward.

Having achieved a change in school culture, schools should start with the open class system, which makes teachers' communication effective and, as a result, makes them confident. This should be followed by the development of teaching materials and promotion of experiments and projects.

(3) Basic infrastructure and facilities

Most of the pilot schools improved basic infrastructure and facilities with the support from parents and community. Since the pilot schools prepared their school development plan together with parents and community, a strong sense of ownership arose, enabling the fullest cooperation from parents and community. As a result, the pilot schools constructed facilities such as teachers' quarters, science laboratories, and libraries at around 50% to 70% of the normal cost. Many pilot schools invited neighboring schools to use their facilities on a regular basis, through which inter-school collaboration was initiated.

However, since this was the first experience for the pilot schools to make a plan and design, procure materials, and monitor the construction work, they had difficulties in managing such a process, and an inefficient use of budget was observed in some schools.

Some pilot schools had difficulties in purchasing expensive equipment such as printing machine, multi-media projector and computers and printers, since they did not have up-to-date information on the equipments as well as on suppliers.

3.5.3 Impact Assessment

To assess the impact of the Pilot Project, the Baseline Survey (BS) and the Post Pilot Survey (PPS) were conducted before and after the implementation of the Pilot Project. Both surveys consisted of Academic Ability Test (AAT) and Questionnaire Survey (QS). BS was conducted in July 2003 and PPS in July – August 2004. In addition, a survey on students' attendance rate was conducted in September 2004.

(1) Academic Ability Test (AAT)

The AAT comprised of sets of multiple-choice questions in the subjects of science and mathematics. It is to measure the impact of the Pilot Project on the students' ability in solving questions[11] in science and mathematics. The same question papers were used for the BS and PPS. AAT was conducted at 8 pilot schools and 8 control schools.

[11] Questions were designed to test abilities of routine procedures, complex procedures, theorizing, and analysing as well as knowledge on mathematics and science.

The means of increments[12] of samples are calculated for the comparison between pilot and control schools. To test the significance level of differences of mean of increments, a t-Test is used. The results are summarized in Table 3.2.

Table 3.2 Analysis of Academic Ability Test Results

Subject		Pilot schools								Control schools								Number of sample		Mean of increment		Comparison of means	Significance level
		Science				Mathematics				Science				Mathematics									
Grade		4/5	8/9	10/11	12/13	4/5	8/9	10/11	12/13	4/5	8/9	10/11	12/13	4/5	8/9	10/11	12/13	Pilot	Control	Pilot	Control		
Overall Comparison		○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	1198	1202	2.19	1.51	P>C	**
Comparison by Subject	Science	○	○	○	○					○	○	○	○					586	602	2.13	1.54	P>C	*
	Mathematics					○	○	○	○					○	○	○	○	612	600	2.25	1.49	P>C	**
Comparison by Grade	4/5	○				○				○				○				284	266	2.35	2.33	P>C	ns
	8/9		○				○				○				○			350	360	2.59	1.87	P>C	*
	10/11			○				○				○				○		327	372	2.16	0.68	P>C	**
	12/13				○				○				○				○	237	204	1.46	1.36	P>C	ns

Note ** Significant at 1% level; * Significant at 5% level; ns Not significant
Source: JICA Study Team

1) Overall Comparison

Means of the increments in individual students' marks are calculated. Mean of pilot schools (2.19) is larger than that of control schools (1.51), with the difference being extremely significant by t-Test. This indicates that there was a certain impact on the students' overall academic ability by the Pilot Project.

2) Comparison by Subject

Means of the increments in individual students' marks in each subject are calculated. In both science and mathematics, means of pilot schools are larger than those of control schools, both at a statistically significant level. This result indicates that an impact on academic ability was observed in both subjects.

3) Comparison by Grade

Means of the increments in individual students' marks in each grade are calculated. In all four grades, means of pilot schools are larger than those of control schools. The differences are statistically significant at 0.01 level in grades 8/9 and 10/11, while not significant in grades 4/5 and 12/13.

(2) Questionnaire Survey (QS)

The QS consisted of a series of quantitative and qualitative questions leading to various indicators of input, process and output to measure the quality of education at the school level. The QS was conducted in all 25 pilot schools and the 8 control schools which were selected for the AAT.

[12] Definition of increment of each individual student for a test is:
Increment = (Mark in PPS) – (Mark in BS).

Table 3.3 shows the indicators that had statistically significant (at 1% or 5% level) difference of the increments in comparison of pilot schools and control schools. It contains the data source and the difference of the means of the increments from BS to PPS in pilot schools and control schools.

Table 3.3 Summary of Questionnaire Survey Results

Indicators		Data source	PPS – BS		P /C	t-Test
			P	C		
1	Infrastructure	Pr	3.72	-0.38	>	**
2	Teaching Facilities	Pr	10.22	2.57	>	*
3	Parents' Support	S	0.22	0.14	>	*
4	School Climate	S	0.19	0.06	>	**
5	Teaching Method	T	0.14	-0.10	>	**
6	Use of Teaching Aids in Maths	S	0.31	0.15	>	**
7	Use of Teaching Aids	T	0.34	-0.02	>	**
8	Evaluation of Maths Class	S	0.12	0.01	>	**
9	Evaluation of Science Class	S	0.13	0.05	>	*
10	Parents' Satisfaction with School	S	0.15	0.00	>	**
11	Parents' Satisfaction with School	Pa	0.21	0.09	>	**
12	Parents' Satisfaction with Math Education	Pa	+11.1%	-3.1%	>	**
13	Parents' Satisfaction with Science Education	Pa	+9.2%	-10.1%	>	**
14	Students' Interest in Maths	S	+4.7%	+1.9%	>	**
15	Students' Interest in Science	S	+2.4%	-1.1%	>	**
16	Students' Interest in Science and Maths	T	0.40	0.12	>	**
17	Students' Education Goal	S	+3.6%	-0.1%	>	**

Note: Data Source: Respondents (Pr for Principal, T for teachers, S for students, Pa for parents)
PPS – BS: Mean difference between PPS result and Baseline Survey
P for Pilot Schools, C for Control Schools
P>C: If the mean (or rate) from Pilot Schools is greater than that from Control Schools, X is noted.
t-Test: ** significant at 1% level, * significant at 5% level

Source: JICA Study Team

The following are the summary of findings from the above results.

1) Improvement in School Management

When compared between pilot and control schools the improvement was larger in pilot schools in all the indicators related to school culture and school management. The improvement in pilot schools was significantly larger in the indicators of *School Climate* (students' rating), *Parents' Satisfaction with School* (both students' and parents' rating), and *Parents' Support* (students' rating).

Although it is not possible to determine which activity in the Pilot Project has brought such improvements, it is probably reasonable to assume that the Pilot Project as a whole has benefited in improving school culture, parents' support, and satisfaction with school.

In the comparison among pilot schools, the increment was much greater in non-Type 1AB schools and schools in rural/ plantation areas than Type 1AB schools and urban schools. Small rural schools, which are in general poorly equipped and with less attention to education, seemed to have been benefited from the Project more than the schools in urban areas.

2) Improvement in Science and Mathematics Teaching and Learning

Improvement was greater in pilot schools in all but one indicator related to the category of science and mathematics teaching and learning[13]. There was a significantly greater improvement in pilot schools for *Science/Maths Teaching Method* (teachers' rating), *Use of Teaching Aids in Maths* (students' rating), *Use of Teaching Aids* (teachers' rating), *Evaluation of Science and Maths Class* (students' rating), and *Parents' Satisfaction with Science and Maths Education in School* (parents' rating).

It can be inferred from the above that the Pilot Project has succeeded in improving teaching and learning process in science and mathematics. Significant improvement in *Teachers' General Teaching Ability* may be interpreted that the impact of the Project was not limited to science and mathematics but it has contributed to improvement in other subjects.

3) Improvement in Basic Infrastructure and School Facilities

Improvement in *School Facilities*, *Infrastructure*, *Teaching Facilities*, and *Science Lab, Maths and PC Room* was greater in pilot schools than control schools. Improvement in pilot schools was significant in the case of *Infrastructure* and *Teaching Facilities*. The question was included only in Principal's Questionnaire, thus the sample number is too small to further analyze the results.

(3) Survey on Attendance Rates of Students

This survey was conducted by collecting the attendance rates[14] of students in the 25 pilot schools. The grades for this survey are 2, 4, 8, and 10 and the months are March and July[15] in 2003 and 2004. The results are summarized in Table 3.4.

[13] The improvement was slightly greater in control schools only for Use of Teaching Aids in Science.
[14] The attendance rates were expressed as a percentage of the actual student days to the expected student days for the month.
[15] These grades and months were selected in due consideration of minimizing the influence of school activities and vacation periods as well as of national examinations.

Table 3.4 Analysis of Attendance Rates by Grades

Grade	Number of Sample		Average of Attendance Rates							
			March				July			
	2003 (class)	2004 (class)	2003 (%)	2004 (%)	Difference (%)	t-Test	2003 (%)	2004 (%)	Difference (%)	t-Test
2	46	49	87.10	87.40	0.30	ns	84.67	87.04	2.38	ns
4	46	51	86.71	87.13	0.42	ns	85.70	87.71	2.01	ns
8	68	75	86.33	87.74	1.41	ns	86.26	88.21	1.95	ns
10	68	74	87.23	85.63	-1.59	ns	85.89	85.51	-0.38	ns
2, 4, 8, 10	228	249	86.83	86.92	0.09	ns	85.72	87.08	1.36	*

Note *: Significant at the 5% level; ns: Not significant

Source: JICA Study Team

An increase can be seen in all grades except for grade 10 in both March and July comparisons. Though the difference in each grade is not statistically significant, the average attendance rate shows a statistically significant increase (at 5% level) in the July comparison when all the grades are combined.

In order to look further into the impact of the Pilot Project on students' attendance, the attendance rates of grades 2, 4, 8 were analyzed based on the location of the schools (urban, semi-urban, rural, and plantation), as shown in Table 3.5. All schools except plantation schools show an increase in attendance rates in both months. Among them, the increase in semi-urban and rural schools is statistically significant at 1% and 5% levels respectively in July 2004 over 2003.

Table 3.5 Analysis of Attendance Rates by Location

Grade	School loation	Number of Sample		Average of Attendant Rates							
				March				July			
		2003 (class)	2004 (class)	2003 (%)	2004 (%)	Difference (%)	t-Test	2003 (%)	2004 (%)	Difference (%)	t-Test
2, 4, 8	Urban	61	72	89.45	90.16	0.71	ns	89.81	90.40	0.59	ns
2, 4, 8	Semi-urban	52	54	87.43	88.08	0.65	ns	85.65	88.19	2.54	**
2, 4, 8	Rural	35	37	82.15	83.81	1.66	ns	80.15	84.80	4.65	*
2, 4, 8	Plantation	12	12	82.28	79.80	-2.48	ns	80.44	78.82	-1.62	ns

Note **: Significant at the 1% level; *: Significant at the 5% level; ns: Not significant

Source: JICA Study Team

This shows that the Educational Kaizen activities of the Pilot Project were effective in improving the attendance of the typically most disadvantaged schools, namely those located in a rural area. On the other hand, urban schools that had already achieved and maintained relatively high rates of attendance show a smaller increase. Plantation schools showed negative change, which indicates that other factors, such as parents' level of awareness, serious shortage of teachers, etc., might have affected the attendance of students more than the activities of the Pilot Project did.

(4) Overall Impact Assessment

Through the analyses of three impact assessment surveys presented above, it was shown at a statistically significant level that the intervention by the Pilot Project contributed to an improvement in school management, science and mathematics education and basic infrastructure and facilities. However, a one-year period is rather too short to bring a significant improvement in such various aspects at school, and thus the increments were at a fairly minimal level. The relationship between evaluation by monitoring activities and results of these impact surveys is illustrated in Figure 3.5. The overall impact assessment can be summarized below:

a) The Educational Kaizen approach functioned quite well and the school management improved, which was proved by the indicators in the Questionnaire Survey related to school management. This indicates that Educational Kaizen activities could help the pilot schools improve their managerial capability.

b) Having activated school culture as the foundation for improvement, a number of interventions by the Pilot Project started to take effect on improving the quality of education in science and mathematics, such as development of teaching materials by teachers, training for model experiments, introduction of open class, and implementation of 100-box calculation. This improvement was proved by the indicators related to science and mathematics education in QS and the results of AAT. It implies that Educational Kaizen activities contributed toward the improvement of quality and efficiency.

c) Activated school culture encouraged participation of parents and community in developing basic infrastructure and facilities. It was proved by the indicators related to school management and basic infrastructure and facilities in QS.

d) As a combined effect of these interventions mentioned above, the pilot schools became a valuable and attractive place for students to go everyday. Consequently, the students' attendance rates increased. It implies that Educational Kaizen activities contributed toward the improvement of access and equity.

e) In addition, these surveys discovered that the Pilot Project provided a bigger impact on non-urban schools than on urban schools and likewise bigger on non-Type 1AB schools than Type 1AB schools. It indicates that Educational Kaizen approach could contribute to minimizing inequity among schools.

f) However, the Educational Kaizen approach at school level is not all-round in improving school management, science and mathematics education and basic infrastructure and facility. Without proper guidance from MOE and NIE, the schools cannot accomplish remarkable progress, particularly in quality improvement of science and mathematics education. Necessary instruction manuals, equipment and materials for

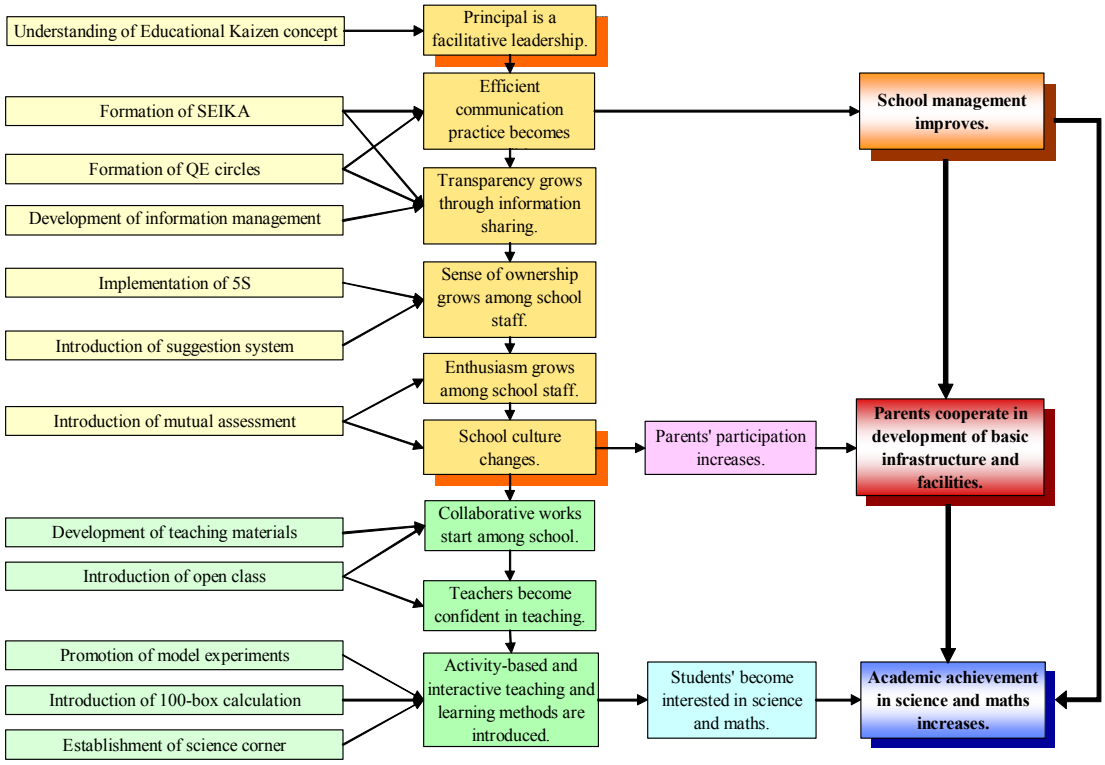
experiment should be supplied by NIE, since many schools are not capable enough to develop experiments for the latest topics. Expensive machines such as computer, printer and duplication machine should be supplied by MOE, since the schools have difficulties to collect and evaluate necessary information of these machines.

Source: JICA Study Team

Figure 3.5 Results of Monitoring and Impact Surveys

Figure 3.6 illustrates a model development process of the pilot schools in relation to various interventions by the Pilot Project. Based on the experience

with the 25 pilot schools, it was found that an open and activated school culture is a prerequisite to improve science and mathematics education and basic infrastructure and facilities. And to develop such school culture, facilitative leadership of the principal is a necessary condition.



Source: JICA Study Team

Figure 3.6 Development Process and the Outcome of the Pilot Schools

3.6 Lessons Learned

Lessons learned through QE circle activities during the Pilot Project were summarized as shown in Table 3.6 and lessons learned through activities to support QE circles were summarized as shown in Table 3.7.

In order to expand Educational Kaizen activities island-wide, the key issues can be summarized as follows:

- Schools have to change their culture by improving communication practice, which can be done by implementing a combination of Educational Kaizen methods such as QE circle activities, 5S and suggestion system.
- Transparency is the basic necessary condition for Educational Kaizen activities in schools, which can be achieved through involvement of external persons such as representatives of zonal offices, parents and community.

- Facilitative leadership of principal is the most important factor in introducing Educational Kaizen activities, for which principals' training for practical management is necessary.
- Frequent monitoring visits are needed for all parties concerned to make a full understanding of benefits and methods in implementing Educational Kaizen activities at schools.
- Schools can implement Educational Kaizen activities without a large amount of budget, if there is a consensus among principal, teachers and parents. In due consideration of the sustainability, allocation of smaller amount is more practical and realistic.
- Capacity development of provincial and zonal offices is needed particularly in the areas of monitoring, evaluation and financial management. Educational Kaizen activities can not be sustainable without driving force of provincial and zonal offices.
- Policy backing by MOE and NIE is mandatory to disseminate Educational Kaizen activities at schools, for which proper institutional setup is needed.
- Awareness campaign for Educational Kaizen activities as well as science and mathematics education is necessary to have a consensus among the entire nation.

Table 3.6 Lessons Learned from the Pilot Project (1)

－Through QE Circle Activities －

Results	Lessons Learned
I. School management	
School culture changed and school staff became activated in most of pilot schools through Educational Kaizen activities. Also, school management was strengthened and became more efficient in those schools.	• Educational Kaizen activities can be applied to the education sector to strengthen management, education and infrastructure/facility. • Schools could change their culture through a combination of Kaizen methods such as QE circle activities, 5S, suggestion system, and raise the motivation of teachers and cooperation of parents. • Key factor in improving school culture was the good communication practice. • The success factors of SEIKA were: 1) facilitative leadership of the principal; 2) open discussion among representatives of different groups in the school/community; 3) transparency in decision-making process including financial matter; 4) regular meetings; and 5) maintenance of minutes of meeting. • Transparency can be maintained if members from outside the school are involved. Particularly involvement of zonal officers was essential. • However, it is not easy for all QE circle members to understand the benefit of and commit themselves to the activities. QE circle leader should share the results with them and try to make family-like culture. Through this process, many QE circle members experienced the feeling that they suddenly became one family. • There are a few principals identified who could not understand a concept and benefit of Educational Kaizen activities, in spite of cooperation provided by teachers and parents. A quality-based deployment system for principals should be introduced based on the proper evaluation.
II. Science and mathematics education	
Many teachers started to think of the ways to improve the quality of science and mathematics education.	• Quality education is not possible without teachers' motivation. • Through Educational Kaizen activities, teachers learned to work cooperatively to improve quality of education. • Teachers could make various efforts to improve quality of education such as developing teaching materials, upgrading laboratory facilities, introducing practical lessons and interactive teaching and learning, conducting extra classes. They

	realized that teaching is not just a job but a service to students. • One of the constraints for teachers to think of new and original teaching and learning method was that they misunderstood that they had to follow exactly what is said in the teachers' guides and syllabus. There was the same misunderstanding in some of the zonal officers too. • It takes time to change teachers' attitudes and it takes even more time for students to really benefit from the changed teachers' attitudes and teaching methods. A continuous effort by school is a must with necessary assistance from MOE/NIE as well as provincial/zonal offices. • There are some limitations for teacher to develop and prepare model experiments for the latest science and mathematics topics. This cutting-edge model experiment should be developed by NIE and all necessary teaching guides, equipment and materials should also be supplied by MOE/NIE.
III. Basic infrastructure and facilities	
Most of the pilot schools improved basic infrastructure and educational facilities with the support from parents.	• When pilot schools were allowed to prepare their development plan based on their needs and priority, they could improve basic infrastructure and educational facilities with a strong sense of ownership. • Because of this ownership, many pilot schools received the fullest cooperation of parents. • A cooperative culture was developed among school, parents and community. • With the support from parents, the pilot schools constructed such facilities as teachers' quarters, science laboratory, mathematics room, library, science garden at around 50 to 70% of ordinary cost. • Many pilot schools invited neighbouring schools to use their facilities on a regular basis.

Table 3.7 Lessons Learned from the Pilot Project (2)

– Through Activities to Support QE Circles –

Results	Lessons learned
I. Preparation	
During the 5-month preparation, 25 pilot schools were selected and provided with orientation and guidance on school development plan and financial management.	• It was not easy to make school staff understand the concept, objective, approach and implementation scheme of the Project, since the nature of the Project was completely new to them. • Transparency can be maintained under a rule that every receipt required signatures of majority of SEIKA members for approval. Financial report should be open to everybody. • Since all pilot activities were designed and implemented through discussions between JICA Study Team and Counterpart Team, know-how and experience of the Project were shared. However, since Counterpart members could not be involved on a full-time basis, some administrative and financial skills could not be transferred well. These skills are critical for government officials, when SBM is introduced. • Participation of provincial/zonal officers in school-based activities made the pilot schools more active and transparent. The Project should have involved them more from the beginning, although this might have caused a slow and time consuming implementation.
II. Workshop and convention	
A range of workshops were held, in Colombo and at the pilot schools, to facilitate the Educational Kaizen activities. A total of over 7,000 person-days were involved.	• Inter-school network gradually developed among nearby pilot schools and they started exchanging resources such as teaching materials. Some schools held joint workshops. • Teachers became confident through conducting model experiments jointly with other teachers, Counterpart Team and JICA Study Team at the workshops. It was the first experience for most of teachers to do these kinds of experiments in an interactive teaching and learning manner. They realized how it can attract the interests of students.

Results	Lessons learned
III. Support and supervision	
JICA Study Team, together with the Counterpart Team, provided support and guidance to the pilot schools through monitoring activities and training, both in Colombo and on-site.	• On-site consultation was the most and only effective way for pilot schools to gain a full understanding among all members. Even if they have a lot of questions and unclear points, they rarely raise questions at workshops and never call and ask questions to clarify or confirm. Therefore, regular monitoring visit is a necessary and powerful tool to ensure information transfer to school. It was not enough to transfer information only by workshops and documents. • Regular financial inspection is critical, such as verifying purchased items, receipts, amount of money spent, bank statement, etc., since pilot schools were not so much familiar with financial management. • Inspection program provided pilot school with practical and efficient on-the-job training to prepare summarized report of pilot activities and financial report. Such skills are extremely important when implementing SBM.

CHAPTER IV

MASTER PLAN TO IMPROVE SCIENCE AND MATHEMATICS EDUCATION

4.1 Rationale and Methodology

4.1.1 Rationale for Development of Science and Mathematics Education

In July 2004, the new administration issued a development policy paper, "Creating Our Future, Building Our Nation". It calls for the annual GDP growth rate of 6-8%, balanced regional development and the reduction of poverty. In the development strategy, the education sector is expected to play a central role to attain the targets of economic growth and poverty reduction.

The country began its concerted effort to strengthen education with the introduction of an Education Reform in 1997. After issuing Reforms in General Education in 1997, the National Education Commission (NEC) developed a new set of reform policy proposals in 2003. The proposed Reform aims to improve the education system by expanding opportunities for all school-age children and youth to access quality education. The Reform states the strengthening of science and mathematics education including IT education as a strategic priority in education. Specifically, the Reform requires teaching of science and mathematics to stress more practical aspects and activity-based methods.

Implementation of the Reform has helped improve access and efficiency. The completion rates of primary and junior secondary education rose to 98% and 83%, respectively, and the repetition rate fell to 1% at G5 (School Census 2003). However, the quality of education, particularly that of science and mathematics has remained unsatisfactory with the pass rates at O-Level and A-Level lower than the corresponding rates in other subjects.

In due consideration of the importance of science and mathematics that form foundation of the succeeding subjects, improvement of these seems prerequisite for the quality improvement. Comprehensive and integrated improvement of science and mathematics at the primary and secondary levels is essential as a key foundation to move up to a higher level of the education ladder. It is also necessary to produce the quality labor force in response to the technologically advancing world of industry.

Further, the Government has recently adopted an approach to examine and address issues of the education sector as a whole, i.e., sector-wide approach being supported by international donors. A comprehensive plan for the

sub-sector of science and mathematics to be prepared in this study will, therefore, constitute an important part of the sector-wide approach.

Meanwhile, the Government of Japan has been implementing various cooperation projects through JICA for the development of science and mathematics in primary and secondary levels not only in Asia but also in South America and Africa. In implementing these projects, experience and know-how focusing on its quality improvement in this sub-sector are accumulated through curriculum improvement and training of teachers. JICA is well positioned to cooperate for preparation of this master plan for science and mathematics education through these experiences.

4.1.2 Methodology

Introduction and implementation of the Pilot Project is a specific characteristic for the plan formulation in this study. The Pilot Project aimed to strengthen science and mathematics at the school level has provided numerous insights to progress made by primary and secondary schools as well as problems they are facing. It has also provided valuable lessons and directions of future plans and programs for science and mathematics development.

In addition to the Pilot Project, the Master Plan has been prepared on the basis of reviews of a number of previous studies and related documents, surveys of selected schools and the labor market, and extensive consultation with and participation by MOE, NIE and various other organizations concerned.

(1) Review Work

Prior to formulating design and implementation of the Pilot Project, various review works were conducted including the following:

- Review on the economic policy and policy on education
- Review on education sector, and science and mathematics education
- Review on the external assistance on education

Through this review work, direction of the national policy on economy and education sector was confirmed. Then, problems and constraints of the education sector and sub-sector on science and mathematics were identified, and the relation of the external assistance with the national policy was confirmed.

(2) Supplemental Surveys

For getting the supplemental information of the sector and projecting labor market situation in the future, the following surveys were carried out in parallel to the above review works:

- School survey covering 144 schools island-wide
- Labor market survey

(3) Pilot Project

Results of the above surveys were integrated into the analysis of the current situation. Following to the sector analysis, analysis was also carried out on the school activities, based on which design of the Pilot Project was prepared. Problems at school level are actually reflection of the problems of the education sector, against which improvement plans were formulated at school level in the Pilot Project.

The Pilot Project was planned to be implemented for the period of 8 months initially, but later extended to about one year. For evaluating the effects and impacts, Baseline Survey and Post Pilot Survey were conducted at the initial stage and closing stage of the Pilot Project. Through the comparison of these surveys, key factors of the success and failure were identified as well as impacts of the Pilot Project.

(4) Master Plan

Formulation of the Master Plan was made by applying this experience and lessons learned through the Pilot Project to the improvement plan for Educational Kaizen activities. The School-based improvement plans were firstly prepared to be implemented at school level. Then, institutional and organizational plans for supporting the School-based activities were formulated at central and local levels of the implementing agencies.

For the preparation of the Master Plan, goals or targets were firstly selected and set out as well as formulation of the strategies. Then, programs and projects for the development of science and mathematics education were prepared both at school level and institutional levels.

Action plan was prepared selecting the early implementation projects from the proposed plan. Implementing arrangement including setting up of organizations, staff arrangement and scheduling for implementation was also planned in order to facilitate the implementation of the action plan.

The approach to the Master Plan is summarized and presented in the Figure 4.1.

The Counterpart personnel assigned to JICA Study Team have been involved in the Study from the stage of the review on the current situation and problem identification, design of the Pilot Project, monitoring and evaluation of the Pilot Project, and up to the stage of improvement plan formulation. Various kinds of workshops and seminars were held inviting stakeholders almost every month in addition to weekly meetings with the Counterpart personnel. Intensive participation of the implementing agencies in the Study and sharing the common understanding among them is one of the specific methodologies applied to this study for the Master Plan.

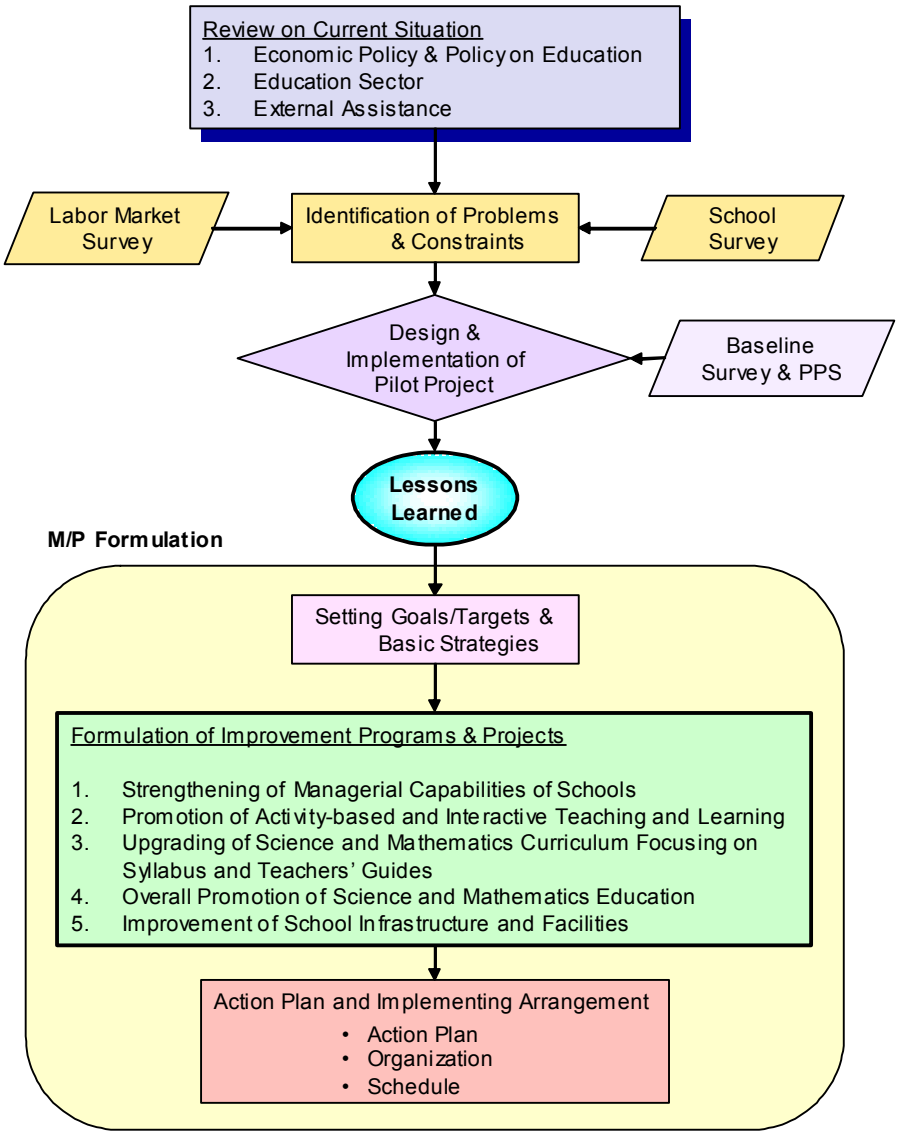


Figure 4.1 Approach to the Master Plan

4.2 Plan Period, Goals and Strategy

4.2.1 Plan Period and Goals

The Master Plan which extends over the period between 2005 and 2012 will be implemented in two phases consisting of short term (2005-2007) and long-term (2008-2012).

As explained later, one of the most important strategies for the improvement of science and mathematics education is to apply and implement the Educational Kaizen activities at school level. It is, therefore, planned that the goal of this plan is to expand the number of school implementing the Educational Kaizen

activities to around 500[16] schools in the short- term, and to all the government schools in the long-term, and to attain the improvement of the sub-sector. Through this, the following indicators concerned with efficiency, quality, sub-sector expansion, and equity are planned to be realized at the target year (2012).

- Efficiency - reduction of the drop-out rate in primary schools to less than 3% at grade 5;
- Quality - increase in the pass rates of science and mathematics in O-Level by 30% (based on the past 3 years average);
- Expansion of the science and mathematics sub-sector - increase number of students qualifying for universities in science/mathematics stream by 25%;
- Equity - improvement in equity between rural and urban schools by recruiting 100% graduate teachers for science and mathematics, and by upgrading science facilities in Type 1AB and 1C schools particularly in rural area.

4.2.2 Strategies

Strategies for the Master Plan have been set out following the reviews of the national policy on education presented in the Education Reform and the Education Development Plan for primary and secondary education. The reviews have led to the following findings:

- Science (included in the Environment Related Activities) and mathematics are designated as key subjects among the four taught in primary school and more learning time will be allocated to these subjects;
- To improve science and mathematics education, activity-based and student-centered teaching is to be introduced with the provision of adequate laboratory and other related facilities;
- School-based management (SBM) will be encouraged by devolving greater authority to schools and increasing community participation; and
- These policies have also been supported by international aid agencies such as the IBRD, ADB, DFID, GTZ and UNICEF. Recently, the Government agreed with the IBRD to implement Sector Wide Approach (SWAp) for education development. SWAp calls for schools to formulate their own development plans.

The above in-depth reviews and analyses of current education issues have provided the background to the development of strategies for the Master Plan as summarized below.

[16] The Program targets around 5% of all schools by 2007 and all government schools (9,790) by 2012 through the cascade system.

a) A school-based approach or Educational Kaizen activities applied to the Pilot Project are used as the key strategy for formulating the Master Plan.

So far, various projects have been implemented mainly from top-down for the improvement of primary and secondary education as explained in the preceding chapters. However, it is very difficult to make them effective and produce the expected results for improvement. This is because the school community is not involved and they have no positive participation in the process.

The Pilot Project focused on this school-based activity and took up the Educational Kaizen activities as a key to improvement. Through the implementation of the Pilot Project, it was found that:

- Motivation of principals and teachers is increased and management capability of school is substantially improved through intensive participation of students and parents.
- Students' interest in science and mathematics is increased through the introduction of activity-based teaching and interactive teaching and learning method at schools.
- School infrastructure and facilities are improved through community participation that contributes to a better school environment and enhancing their ownership.
- Finally, the school culture is changed into more active and progressive one through the above.

Confirming the above results, the experience and lessons gained through the implementation of the Pilot Project are fully applied to the plan formulation.

b) For the improvement of quality in science and mathematics, the following strategic approaches are applied:

- Students' interest in science and mathematics is to be enhanced at the primary and junior secondary levels and their basic capability is to be strengthened through introduction of model experiments, project/research, 100 box calculation, etc.
- Activity-based teaching and interactive teaching and learning method are to be intensively introduced for science and mathematics education.
- Modification of syllabus and teachers' guide in science and mathematics is to be made corresponding to the introduction of above.

c) In the plan formulation, establishing the school framework for Educational Kaizen activities and strengthening of school management system are given first priority, together with strengthening activity-based teaching and learning at school level.

d) Then, institutional and organizational support is planned as a top-down approach for facilitating the school-based approach. This approach contains institutional and organizational development and capacity building of central and local offices of the implementing agencies.

Upgrading the curriculum of science and mathematics is also planned as well as improvement of science facilities as another Top-down Approach.

The plans using top-down approaches have to be implemented simultaneously to achieve a smooth introduction of Educational Kaizen activities at the school level.

e) Finally, overall improvement for science and mathematics education through facilities improvement and enhancement of the awareness is taken up as a strategy for the plan formulation in due consideration of the fact that importance of the two subjects is not well recognized among students and parents and further promotion is indispensable for the society as a whole.

f) Practical and implementable plan formulation is another key strategy for the plan formulation.

Development of science and mathematics education requires a wide range of improvements including basic education framework in the country. The proposed plan focuses on expansion of School-based activity and also related institutional improvement. This focus leads to the preparation of a more practical plan. Intensive involvement of the stakeholders and Counterpart Personnel from the stage of the preparation up to the plan formulation also contributes to formulation of a practical and implementable plan through in-depth sharing of current problems and constraints.

4.3 Plan Formulation

4.3.1 Plan Structure

Process of the Master Plan formulation is briefly explained below.

a) Problems of the education sector are clarified from the view points of "Planning and Management", "Quality of Education" and "Access to Quality Education" through the policy and the sector analysis

b) Then, problems at school are clarified in more detail under the categories of "School Management", "Science and Mathematics Education" and "Basic Infrastructure and Facilities" which correspond to the problems of the above education sector.

c) For solving the school-based problems, the Pilot Project was implemented at the 25 pilot schools island wide.

d) The experience and lessons gained through the Pilot Project are fully utilized for the plan formulation.

The structure of the proposed plan formulated through the above process is explained below and summarized in Figure 4.2.

The proposed plans consist of school-based approach and top-down approach. As for school-based approach, promotion of Educational Kaizen activities at the school level is planned and as for top-down approach the institutional setup at MOE/PEA and NIE is planned. The proposed plans are finally integrated into the following five programs in due consideration of the function of the implementing organization and efficient implementation.

Program 1 is centered on "School Management", while Program 2, 3, and 4 focus on the "Science and Mathematics Education" at school level. Program 5 is proposed against identified problem at school in "Basic Infrastructure and Facilities". Various projects are formulated for attaining the goals of each Program.

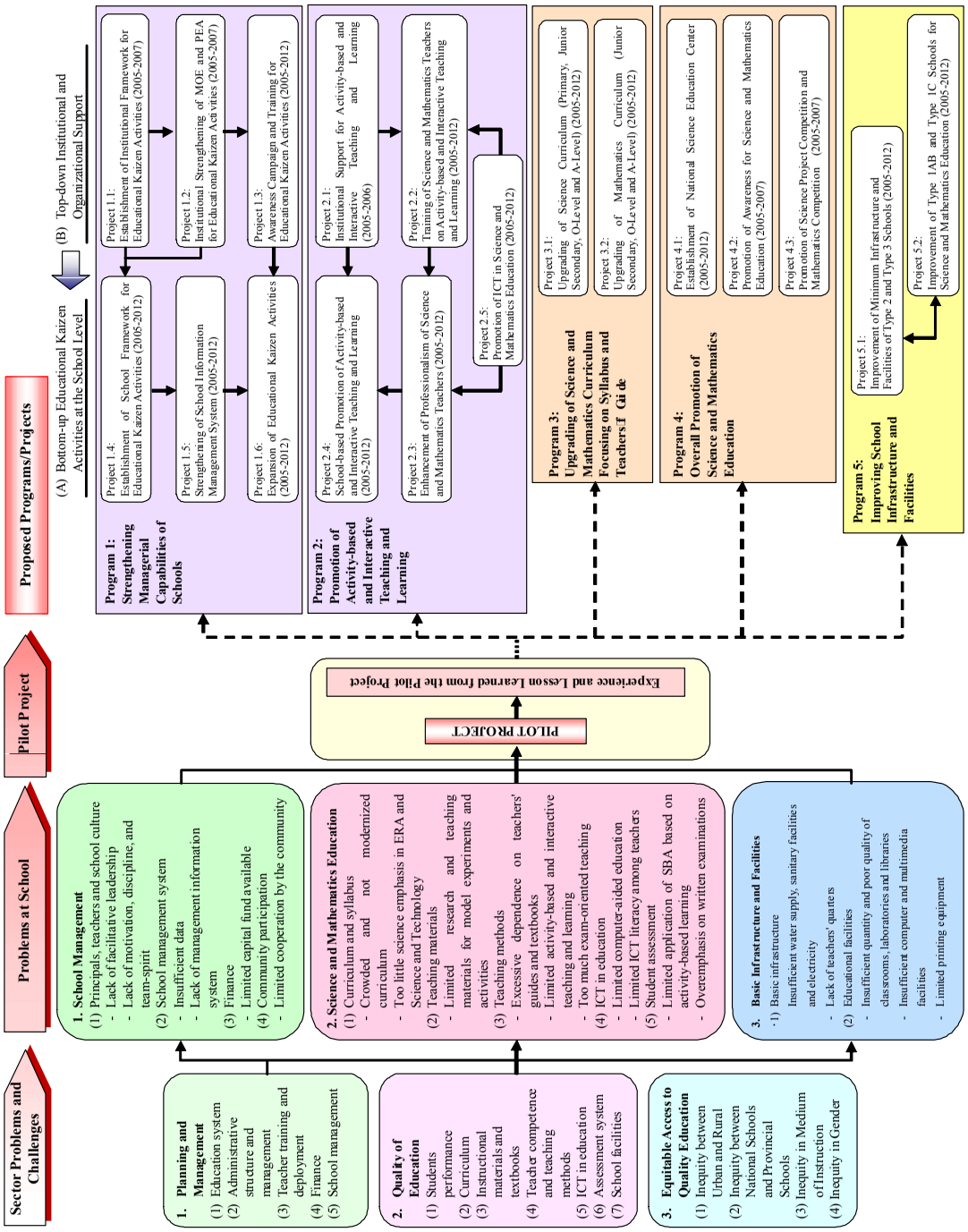


Figure 4.2 Planning Process and Plan Structure of the Proposed Programs

4.3.2 Formulation of Programs

Problems and rationale, and main contents of each program are explained below.

(1) Program 1: Strengthening Managerial Capabilities of Schools

1) Problems and Rationale

Schools have been following the instructions given by MOE for the development of school management, education and basic infrastructure and facilities and are not used to initiating school-based activities to improve quality of education at school level. Under this situation, many schools have been suffering from stagnation in non-active school culture. This causes low motivation of teachers and poor results; (i) limited collaborative works among teachers; (ii) limited cooperation with parents and community; (iii) considerable amount of teaching time lost by teachers' leave and delay to class; and (iv) an outdated theory-oriented teaching method. Consequently, schools are not joyful places for students. This is one of the reasons of student's absenteeism, more priority given to private tuition classes for teachers and less interest in learning, particularly of science and mathematics.

However, 25 pilot schools tried various school-based activities with the support of the JICA Study Team, which proved the educational Kaizen approach was effective to improve school management, education and basic infrastructure/facilities development. It also improved teachers' motivation and raise students' interest in science and mathematics. It proved that schools can change its culture by introducing Educational Kaizen methods such as QE circle activities, 5S and suggestion system. This contributes to improvement of teachers' motivation and enthusiasm as well as active community participation.

In order to expand Educational Kaizen activities, it is important to strengthen managerial capabilities at the school level (bottom-up) and institutional and organizational support by MOE and PEA (top-down).

Figure 4.3 shows how these problems can be addressed by proposed solutions, and how these solutions are organized into the six projects under Program 1.

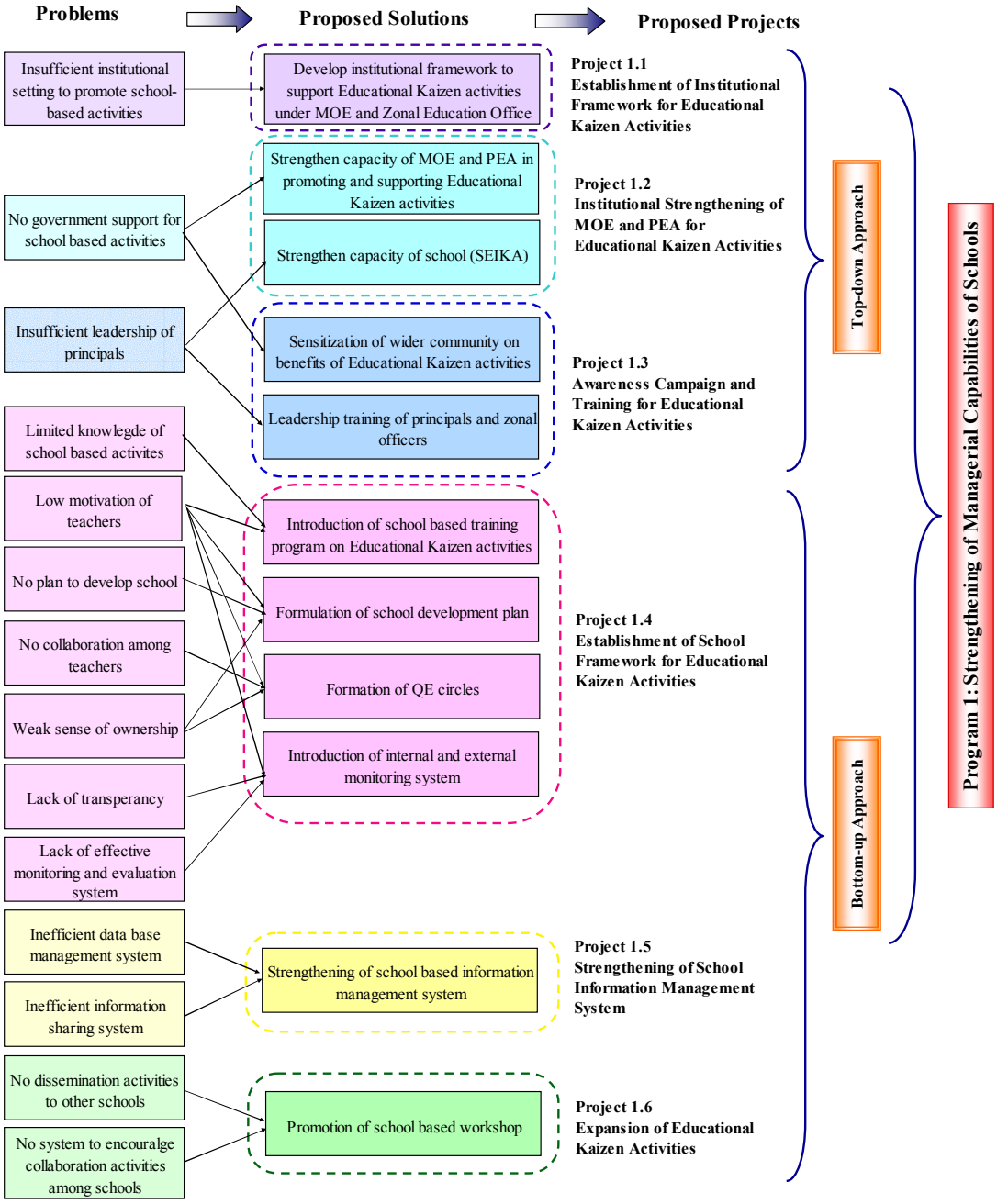


Figure 4.3 Plan Formulation for Program 1

Rationale for each project is described below:

Project 1.1 Establishment of Institutional Framework for Educational Kaizen Activities

Current education administrative setting does not encourage schools to initiate innovative school-based activities. Instead, schools are sometimes restricted by norms set by the government. In this situation, for schools to initiate school-based activities to improve quality of education, it is important to develop institutional setting which encourages and supports school-based

activities. This project will develop institutional framework to support Educational Kaizen activities by setting up a national level committee to provide strong policy backing to promote Educational Kaizen activities at school-level. The project also covers the zonal level institutional setting.

Project 1.2 Institutional Strengthening of MOE and PEA for Educational Kaizen Activities

Following Project 1.1, it is necessary to strengthen MOE and PEA in order for these organizations to take effective supporting roles in implementing Educational Kaizen activities at school level. Under this project a Unit promoting Educational Kaizen activities will be formed under Planning Division of MOE and various training will be designed and implemented by the Unit for capacity building of MOE and PEA, using cascade system.

Project 1.3 Awareness Campaign and Training for Educational Kaizen Activities

The concept of Educational Kaizen is not well spread in Sri Lanka. Therefore, it is important to organize campaign to make wider community to understand the concept and benefit of this approach. Different means of sending the message across will be utilized including media and workshops. The project will make use of materials accumulated by JICA Pilot Project.

For schools to implement Educational Kaizen activities, facilitative leadership of principals and senior teachers is very important. It is also expected that the role of zonal officers will become more important. Therefore, the project will organize leadership training for principals and zonal officers focusing on practical skills and know-how to introduce Educational Kaizen activities.

Project 1.4 Establishment of School Framework for Educational Kaizen Activities

It is not effective to improve school management, quality education and basic infrastructure and facilities only by a top-down approach due to difficulties of MOE and PEA in taking measures to meet with various needs from different kinds of school environment. However, there is no system to promote a bottom-up approach or school-based activities at present. The project establishes a framework for Educational Kaizen activities, in which the school prepares a school development plan and form QE circles. The project encourages participation of all parties concerned in the development process of the school, through which they are motivated. By collaborative works among principal, teachers, parents and students, many managerial problems at school can be solved, quality of education can be improved and basic infrastructure and facilities can be developed and maintained well. No substantial cost is required for these school-based activities and the

development and maintenance costs for basic infrastructure and facilities might become lower with a support of parents and community.

Project 1.5 Strengthening of School Information Management System

In promoting Educational Kaizen activities, it is essential for the school to develop efficient information management system. However, most of the schools do not have proper information management system for data collection, filing and analysis. Under this situation these schools will face difficulties to manage documents, budget, and inventory in implementing Educational Kaizen activities. Some schools have computer facilities and human resources with computer literacy, but most of these schools are not fully utilizing these facilities. The project develops document basis information management system which is transformed to computer basis later. The information includes attendance rates, examination marks, personal data, budget, and inventory, and time table of lessons. Teachers' absence will be monitored and exchange of lessons among teachers will be organized in order to execute annual lesson plan formed in accordance with national curriculum. With the project, all information has to be shared among all parties concerned to maintain transparency, administrative works associated with Educational Kaizen activities have to be managed by computer, scientific data analysis helps the school identify problems and progress and results of analysis provide the school with evaluation indicators of Educational Kaizen activities. Since this system is the school based information management system, only a computer is required at each school, as well as computer training for school staff. Therefore, no significant investment is necessary.

Project 1.6 Expansion of Educational Kaizen Activities

It is effective for the schools, if they can learn know-how, skills and experiences for school improvement among themselves. However, these activities are very limited at present. Hence, the schools are isolated each other from managerial and educational information. The project promotes school-based workshop, focusing on dissemination of outcome developed by Educational Kaizen activities. The school-based workshop motivates all parties concerned and encourages collaborative works among the schools. Those may include joint research works for activity based and interactive teaching and learning and joint development of teaching materials. Since a required cost is only for school-based workshop, no substantial budget is needed for the project.

2) Overall Goal

The following are the goals of the Program:

- To strengthen managerial capabilities of schools by introducing

Educational Kaizen activities in 500[17] schools by 2007 and all (9,790) government schools by 2012

- To develop institutional framework within MOE and PEA to support Educational Kaizen activities

3) Concept of Program and Contents

The concept of the Program is to strengthen managerial capabilities of schools by introducing Educational Kaizen activities in combination with establishment of institutional and organizational support from MOE and PEA.

The Program consists of six projects, three for institutional and organizational support for school-based Educational Kaizen activities and other three for school-based Educational Kaizen activities.

4) Process of Implementation

The following two top-down projects will be initiated:

- Preparation of Institutional Framework for Educational Kaizen Activities
- Institutional Strengthening of MOE and PEA for Educational Kaizen Activities

To follow the above, school-based activities as below will be implemented:

- Establishment of School Framework for Educational Kaizen Activities
- Strengthening of School Information Management System

The implementation on Awareness Campaign and Training and Expansion of Educational Kaizen Activities will follow after the implementation of the above.

(2) Program 2: Promotion of Activity-based and Interactive Teaching and Learning

1) Problems and Rationale

First of all, there are still many rural schools which lack the necessary number of primary school teachers and science and mathematics teachers, because many teachers prefer to work in urban popular schools. Lack of qualified primary school teachers and science and mathematics teachers in rural schools hinders rural children's access to quality science and mathematics education in these schools and worsen urban-rural inequality.

MOE's Education Reform in 1997 and NEC's recommendations in 2003 advocated more use of activity-based and interactive teaching and learning in the classroom, in order to make learning at school more joyful, practical and relevant to students. While primary education has progressed in training

[17] As explained in Sub-section 4.2.1, the Program targets around 5% of all government schools in the short term. IBRD is planning to commence a pilot project with a very similar approach as this Program at 16 zones (2 zones in each province) in 2006 and expand all schools in 2010.

teachers on activity-based and interactive teaching and learning ("Joyful Learning") and implementing it in the classrooms, secondary education is still dominated with lecture-type lessons and written examinations.

Reasons why most of teachers (especially for grade 6-13 teachers) have rarely practiced activity-based and interactive teaching and learning in their lessons are:

- teachers are afraid of practicing new approaches;
- there is no practical support to teachers from ISAs and their teacher colleagues, such as demonstrating activity-based and interactive teaching and learning in the classroom;
- there is no effective performance monitoring and evaluation system of teachers, in order to check whether they are actually using activity-based and interactive teaching and learning in their lessons after training;
- teachers are too busy in teaching all contents of the overcrowded curriculum especially for grade 6-13, and no time to spend for practicals, and;
- teachers are pressured by the parents to provide more exercises for students to better prepare for O-Level and A-Level examinations which are still traditional written examinations.

In order to improve this situation, subject experts such as NIE officers need to strengthen their support for teachers especially in developing teaching materials and methods for activity-based and interactive teaching and learning, since teachers at schools are limited in such capacity. For enhancement of dissemination and utilization of the developed resources of teaching materials and methods, Educational Kaizen Activities will be effective. System such as teachers' society for sharing the educational resources among teachers needs to be established as well.

Figure 4.4 shows how the problems can be addressed by proposed solutions, and how these solutions are organized into the following five projects under Program 2:

- Project 2.1: Institutional Support for Activity-based and Interactive Teaching and Learning
- Project 2.2: Training of Science and Mathematics Teachers on Activity-based and Interactive Teaching and Learning
- Project 2.3: Enhancement of Professionalism of Science and Mathematics Teachers
- Project 2.4: School-based Promotion of Activity-based and Interactive Teaching and Learning
- Project 2.5: Promotion of ICT in Science and Mathematics Education

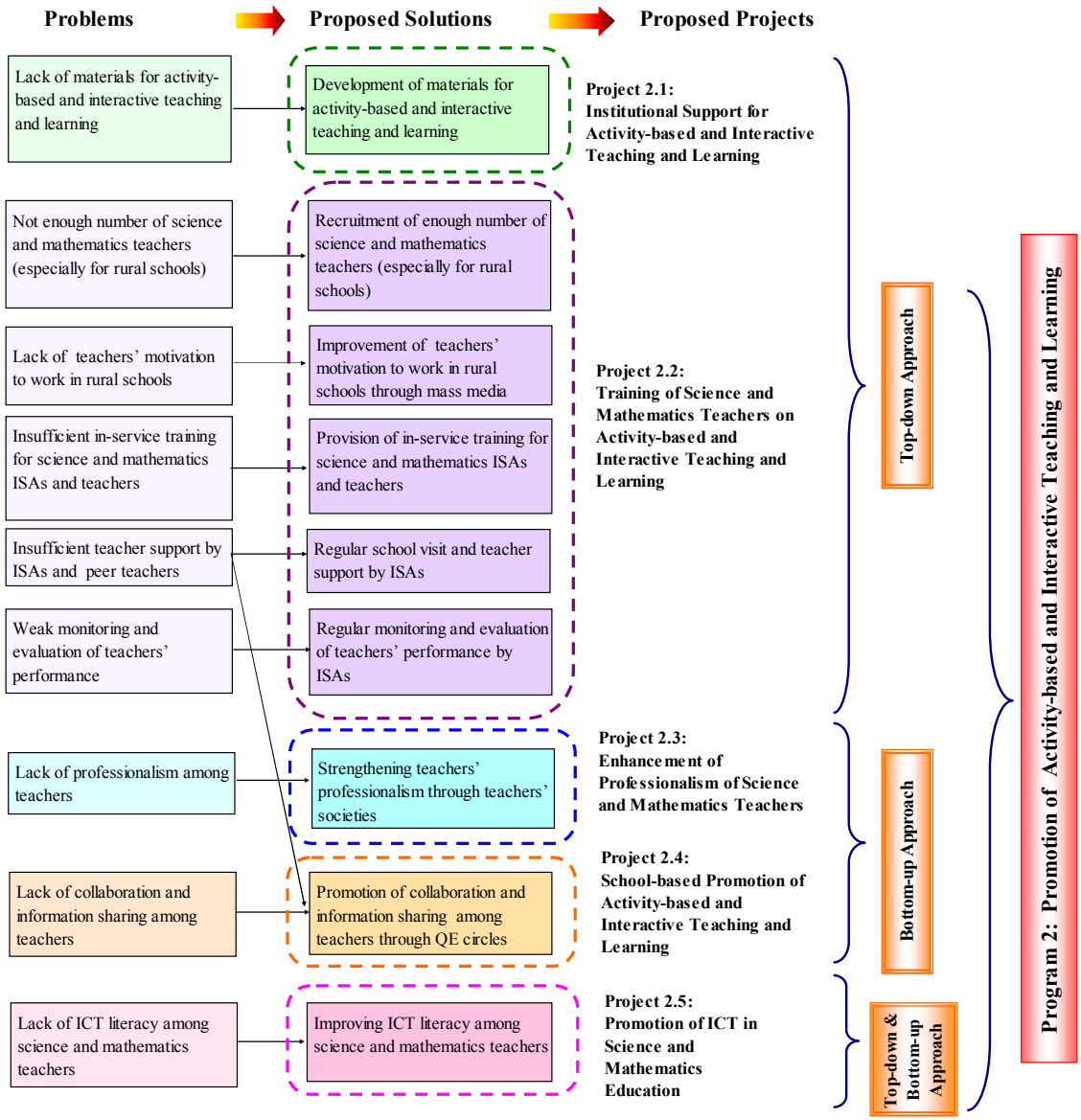


Figure 4.4 Plan Formulation for Program 2

Project 2.1 Institutional Support for Activity-based and Interactive Teaching and Learning

It is not effective to train teachers in methods of activity-based and interactive teaching and learning without using suitable materials, therefore it is important to develop subject-based activity manuals to utilize activity-based and interactive teaching and learning methods. This project will develop a range of subject-based practical activities using interactive methods (real-world activities, where possible) which will increase the students' knowledge and understanding as well as their interest and motivation in the subject. The combination of new teaching methods and new materials is a powerful motivator for teachers to change their approach from teaching only

knowledge, skills and techniques to teaching for understanding of concepts in practical situations.

Project 2.2 Training of Science and Mathematics Teachers on Activity-based and Interactive Teaching and Learning

While many science and mathematics teachers for grade 6 to 13 hear about or have been trained on activity-based and interactive teaching and learning, most of teachers have never practiced them, because they are afraid of new ways, there is no practical support to teachers from ISAs at the classroom level, and there is no effective performance monitoring and evaluation system for ISAs and teachers. So it is important to improve the teaching practices of existing science and mathematics teachers, through a) the cascade system of in-service training in which first NIE staff trains science and mathematics ISAs, then ISAs visit schools and train science and mathematics teachers in the school (in-school training), b) regular school visits and demonstration lessons by ISAs, and c) performance monitoring and evaluation system of science and mathematics ISAs and teachers. System of ISA for A-Level will be also established.

Project 2.3 Enhancement of Professionalism of Science and Mathematics Teachers

Teachers often feel isolated from each other particularly in rural schools. To be effective in the classroom, they need to meet with teachers from other schools in a formal way to discuss new ideas, new teaching methods, share problems and hear the latest from experts in their subject. They will be able to communicate their own experiences through meetings, conferences and the newsletters. It will be the great benefit if subject teacher-based professional societies are established as distinct from general in-service teacher training courses. The societies also act as an excellent form of self-development and continuing education for teachers. It is important that the societies should not be made compulsory for all teachers, but experience overseas[18] has shown that the initial members through their enthusiasm and interests encourage other teachers to take part. There is a need for grade 6-11 teachers and A-Level teachers to meet together so that they can discuss the bigger picture of science and mathematics teaching and learning at all grades in the secondary education. Even though primary school teachers teach all subjects in the curriculum, they will benefit by meeting to look at ideas for teaching and learning ERA and mathematics with a particular emphasis on integration of the subjects.

[18] In Japan, Society of Elementary Mathemtatics Education has been established in 1971 by some voluntary teachers and now expanded to 87 branches all over in Japan.

Project 2.4 School-based Promotion of Activity-based and Interactive Teaching and Learning

The Pilot Project found that a lack of basic calculation skills is one of the most significant constraints hindering students from proceeding to further study in mathematics in Sri Lanka. 100-box calculation is a proven, effective and low-cost method to improve the skills of all students. The Pilot Project also discovered that there is a strong need for teachers to develop their own teaching materials which meet their own school needs. Also, teachers are willing to develop these materials, if facilities are available for them. JICA Pilot Project showed that teachers are prepared to use activity-based and interactive teaching and learning to increase their students' motivation and interest in science and mathematics. However, many teachers lack the ideas, skills, facilities and, most importantly, confidence to prepare practical lessons by themselves and teach these lessons using interactive methods. In order to build up their confidence and skills, a joint development of practical lessons using interactive teaching and learning by a group of teachers is a good method.

Project 2.5 Promotion of ICT in Science and Mathematics Education

ICT literacy among teachers is generally very low in Sri Lanka. For efficient and developed use of ICT in education, the general ICT skills of teachers and their understanding of the educational use of ICT should be strengthened. Helping teachers to produce teaching materials locally using ICT is a good tool for improving science and mathematics education. At present, there is not enough use of ICT for school-based production of teaching materials. Apart from few exceptions, schools have no access to the Internet. There is a need of Internet access to enhance communication between schools and individual teachers. Internet access is also necessary for introducing modern technology and sources of new information in science and mathematics education. Computer Resource Centers (CRCs) are important hubs in both teacher training and maintenance of ICT equipment. To be able to fulfill their tasks, they should be provided with modern computers and peripherals.

2) Overall Goal

The overall goal of Program2 is to improve students' interests and achievements in science and mathematics through promotion of activity-based and interactive teaching and learning in the classroom.

3) Concept of Program and Contents

Five projects in Program2 aim at addressing problems of teachers in the comprehensive manner, that is, a combination of top-down and bottom-up approaches, in order to achieve the above overall goal.

The core objective of Program 2 is to improve science and mathematics

teachers' competence, and Figure 4.5 illustrates how this objective can be achieved by the combination of top-down approach and bottom-up approaches: a) cascade training and follow-up system in Project 2.2, b) promotion of teachers' professional societies in the zone in Project 2.3, and c) promotion of teachers' QE circle in the school in Project 2.4.

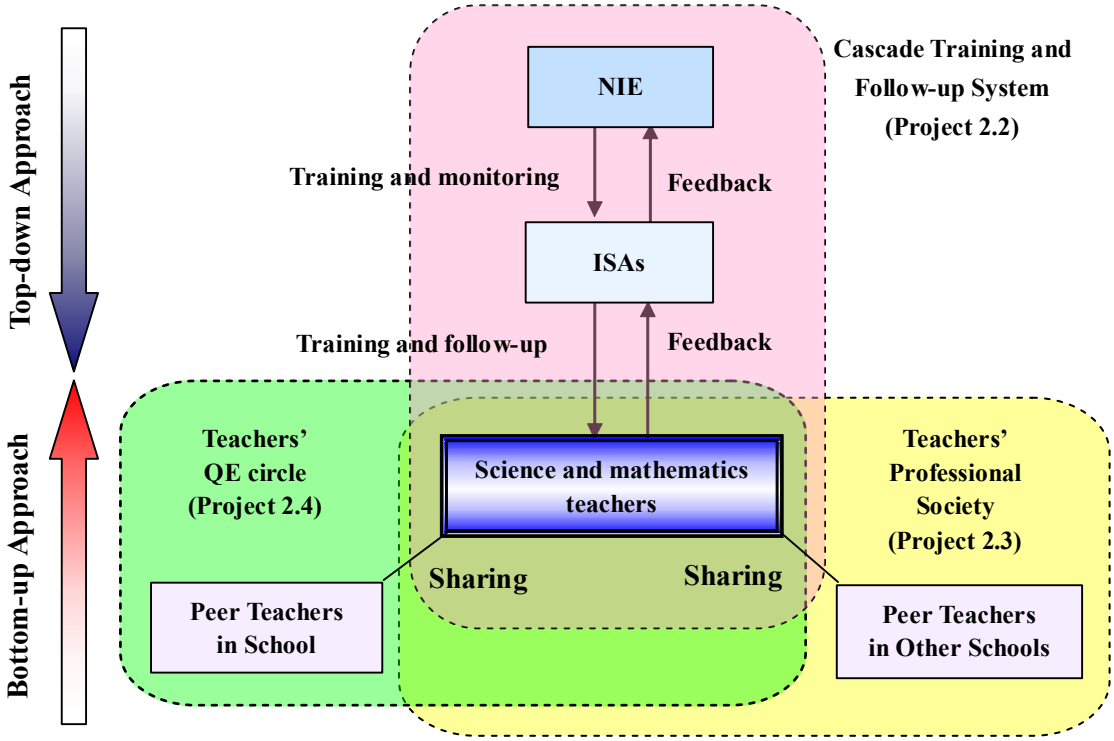


Figure 4.5 Top-down and Bottom-up Approaches for Teacher Empowerment

It is also important to emphasize that the design of these projects are based on successful approaches (such as teachers' QE circles, hand-made teaching materials, in-school training, regular follow-up visits after training) and products (such as 100-box calculation handbook, model experiment handbooks) from JICA Pilot Project.

4) Process of Implementation

Program 2 will be implemented in the following two phases:

(Phase 1) Program 2 will be implemented in the 500 pilot schools, where Educational Kaizen Activities are introduced through implementation of program 1, as the Pilot Phase from 2005 to 2007.

(Phase 2) After analyzing experiences and learning lessons from the Pilot Phase, Program 2 will be re-designed and expanded to all (9,790) government schools from 2008 to 2012.

As for the implementation order of the five projects, Project 2.1 is the foundation to start Project 2.2 and Project 2.4, because NIE's new unit for

activity-based and interactive teaching and learning will play a key role in implementing Project 2.2 and 2.4. The detailed implementation schedule of five projects is shown in the Program Profile.

(3) Program 3: Upgrading Science and Mathematics Curriculum Focusing on Syllabus and Teachers Guides

1) Problems and Rationale

Pass rates in O-Level *'science and technology'* and *mathematics*, A-Level *physical sciences* and '*combined mathematics'* are low. One of the contributing factors to this poor performance is the present curriculum. There are too many topics in most of the syllabuses and many teachers struggle to complete the syllabus. Therefore, they teach only what they think necessary for the written GCE A-Level and GCE O-Level examinations.

Some topics are also outdated and need upgrading or deletion from the various syllabuses. The present syllabuses and teachers guides were also prepared before the implementation of SBA and teachers' guides lack information on activities, practicals, projects, assignments etc. and activity based teaching methods.

For ERA, the present curriculum is arranged in themes and requires more structure and amplification for teachers. As well, both ERA and *'science and technology'* topics need to be linked more closely to science topics.

The problems above form the rationale for curriculum change and that change is to produce a curriculum that will motivate students to both enjoy their studies and improve their performance in science and mathematics.

The curriculum at O-Level and A-Level has reached the end of its present cycle and a review and an upgrade is required for the following reasons:

- The low pass rates in all science subjects except A-Level biology
- The low pass rates in both mathematics subjects
- The need to have vertical integration of science and mathematics(grades1-13)
- The need to build a bridge between the O-Level and A-Level curricula
- The overcrowding of the present curriculum
- Scientific and mathematical knowledge is changing at a rapid rate
- ICT applications need to be included
- Activity based interactive teaching and learning needs to be implemented widely at primary and secondary level
- A range of practicals, projects, assignments have to be prepared for effective implementation of SBA

2) Overall Goals

The following are the goals of the curriculum upgrade:

a) Relevant less-crowded curricula with both concepts and activities included reflecting modern '*science and technology'* and *mathematics* knowledge and real-life situations.

b) To enable teachers to teach the curriculum using modern teaching-learning methods without loss of academic standards

c) To enable students to enjoy learning science and mathematics in an interactive way and to improve their performance

d) An improvement to SBA by allowing more time for practicals, projects, assignments and other activity based tasks

3) Concept of Program and Contents

The concept of the program is to improve science and mathematics in Sri Lankan schools by upgrading the present curricula.

The program consists of the two curriculum projects listed below:

Upgrading of Science Curriculum (Primary, Junior Secondary, O-Level and A-Level)

The ERA curriculum will contain more detail than it does at present. The thematic format will have linkages to science concepts within each theme.

More linkages to science will also be made for the present O-Level '*science and technology'* (grade 6 '*environmental studies'* will be called grade 6 '*science and technology'* for purposes of this document) and the length of the syllabus reduced to allow (a) more time for the students to understand key concepts in a topic and (b) more time for SBA activities such as experiments, projects, field trips etc. Teachers' guides will have more information on syllabus-based activities and activity-based methods related to SBA. Core science topics for students to obtain deeper understanding spending more time will be selected based on the model experiments and activities developed through the Pilot Project.

The emphasis for A-Level Science subjects will be on reducing the content of the curriculum to allow more time for understanding of abstract concepts and for completing practicals, assignments and field trips for SBA. Topics will also be modified in line with contemporary knowledge in the subjects.

Upgrading of Mathematics Curriculum (Junior Secondary, O-Level and A-Level)

The current mathematics curriculum in primary level has been prepared through the DFID project (1998-2004) and does not require upgrading. MOE has decided that the curriculum is to remain unchanged and be taught for

another cycle.

The O-Level curriculum will be reduced and appropriate topics will emphasize practical approaches and activity-based teaching methods. Teachers' guides will have more information on syllabus-based activities and activity-based methods related to SBA. Core mathematics topics for students to obtain deeper understanding spending more time will be selected based on the model experiments and activities developed through the Pilot Project.

As with the A-Level science subjects, the emphasis for A-Level *'combined mathematics'* will be on reducing the content of the curriculum to allow more time for understanding of abstract concepts and for completing projects, assignments for SBA. Topics will also be modified in line with contemporary knowledge in the subject.

The above two projects are not intended to produce new curricula but rather to revise and upgrade the existing curricula taking into account four issues identified by MOE and our study as being important for improving science and mathematics.

These issues are:

- Too many topics and some outdated topics in syllabuses
- Insufficient science emphasis in ERA and O-Level *'science and technology'*
- Present Teachers' Guides give insufficient guidance to teachers on activity based interactive teaching and learning methods particularly for *mathematics*
- Present Teachers' Guides give too few syllabus linked practical activity based examples for teachers

These four issues are the backbone to the revision of the syllabuses and the upgraded curricula should reflect them as the key to improved teaching and learning in science and mathematics.

Even though program 3 is concerned with curriculum, successful implementation of the upgraded curricula in science and mathematics will mean changes to the assessment system to reflect the outputs of the upgrading. This will necessitate change to both the written examination component and SBA component. The written examinations will need to be reframed to allow for content change and more interactive teaching methods and SBA will need to include consideration of new instructional material and methodologies which are part of the outputs for both Program 2 and Program 3. NIE and NETS will need to collaborate on this issue.

4) Process of Implementation

Project implementation will take place in the following priority order:

- Curriculum Upgrading of ERA, Junior Secondary and O-Level '*science and technology'*
- Curriculum Upgrading of junior secondary and O-Level *mathematics*
- Curriculum Upgrading of A-Level *biology*, *chemistry* and *physics*
- Curriculum Revision of A-Level '*combined mathematics'*

For maximum effect, it is important that the upgraded curricula be implemented at primary and O-Level before A-Level implementation. This is so because the new emphases in content and method will reach much larger number of students and at an earlier stage of their education and therefore have more impact.

Following is the implementation process for each of the two projects:

Preparation of curricula, syllabuses and teachers' guides

- Formation of curriculum committees - NIE
- Review and upgrade of present curricula - NIE
- Preparation of upgraded curricula - NIE
- Preparation of upgraded syllabuses – grade-by-grade NIE
- Preparation of upgraded teachers guides – grade-by-grade NIE

Training of personnel by the cascade method

- ISAs, master teachers at NIE – by NIE
- Selected teachers at Teachers Centers – by ISAs, master teachers
- General teachers in schools – by selected teachers
- Using upgraded material
- Implementation in schools

(4) Program 4: Overall Promotion of Science and Mathematics Education

1) Problems and Rationale

The issue of too much emphasis on GCE written examinations has been identified for many years as a major problem in the Sri Lanka education system. Most students, teachers, and parents see secondary education as a means of obtaining high enough marks in A-Level examinations to enter university, while taking little notice of the broader objectives of education. Due to this focus on examinations, their awareness of real-world applications and observations in science and mathematics is very limited. Teachers are not equipped with a practical knowledge of the science and mathematics applications in modern technology and of every day observations of the natural environment. Therefore, students are deprived of deeper understanding of science and mathematics. Since there are few major sources of information, many persons in the general public also have little idea of the important roles of science and technology and mathematics in the world

around them. Therefore, there needs to be positive steps taken to rectify this lack of awareness of science and mathematics among parents, teachers, students and the general public.

The problems above form the rationale for awakening interest in and understanding of science and mathematics among parents, teachers, students and the general public. Accordingly, the following issues need to be addressed.

- Lack of opportunities to publicize the importance of science literacy and numeracy at the national level.
- Lack of understanding among parents of the aims of science and mathematics education as intended by MOE
- Lack of publicity material for the general public including teachers to learn of the latest information on science and mathematics.
- Lack of organized activities at the national level for students to participate in and to gain interest in science and mathematics.

All countries are unable to do away with using examination results for selection for university, further training or employment. However, it still is one of important duties of public education to disseminate the richness and logic of science and mathematics accumulated through human history in observing and explaining man's struggle with nature and the environment.

2) Overall Goal

The following are the goal for the promotion of science and mathematics:

- To have teachers, students, parents and the general public gain an interest in science and mathematics.
- To have teachers, students, parents and the general public understand the importance and usefulness of science and mathematics education besides just being examination subjects.
- To have parents encourage their children to take part in activities relating to science and mathematics.

3) Concept of Program and Contents

The concept of the program is to improve science literacy and numeracy for all people in Sri Lanka. The program consists of the three projects listed below:

a) Establishment of National Science Education Center

This newly established center will provide students as well as the general public with opportunities to *experience science*. In addition to pure science, seeing modern technology with their own eyes will enhance understanding of science applied in their everyday lives. It is very important for the center to

have steady sources of revenue raising otherwise this type of institution may easily become a heavy burden on national finances. For this reason, private sector involvement is important. Centers established in other countries will be thoroughly studied to find suitable model for Sri Lanka.

b) Promotion of Awareness for Mathematics and Science Education

In this project, MOE will develop a strategy for a public awareness campaign of direction of science and mathematics education for today and future. Previous media campaigns will be reviewed and the total concept will be developed as well as most effective use of the various media and awareness material. The attitudes of society to science and mathematics developed through decades need to be changed.

c) Promotion of Science Project Competition and Mathematics Competition

In this project, a mathematics competition and a science project competition will be implemented annually. Although these are organized in the form of competitions, neither selection nor awarding of prizes is the main objective. The main objective is to give school students ideas on how interesting science and mathematics can be apart from just acquiring knowledge and learning skills to gain higher marks in O-Level and A-Level examinations.

3) Process of Implementation

Three projects will be implemented individually, but needs careful coordination of the timing.

a) Establishment of National Science Education Center

Since the National Science Education Center requires construction work, it will be a long-term project. Before and during the construction work, operation management plan will be developed. In addition to plan for general administration, system of financial management will need to be addressed for sustainable financial management. In this process, discussion with private sectors is expected to develop plan for collaboration between public and private sectors. This plan is crucially important since the Center will need to operate continuously once it is established.

Other two activity components, issue of science and mathematics journals and science and mathematics directory, will also be organized by the Steering Committee of the Center. The process of these components will be coordinated in parallel with the process of the National Science Education Center.

b) Promotion of Awareness for Science and Mathematics Education

Without appropriate awareness among general public, education will not direct students in expected manner. Therefore, this project needs to be implemented as soon as possible to bring about the most positive effects upon

all other projects and upon permanent education services.

c) Promotion of Science Project Competition and Mathematics Competition

This project will be implemented in three steps, i.e. 1) pilot implementation in selected 16 zones, 2) Nation-wide implementation up to Provincial final, 3) nation-wide implementation up to national final. Training for Zonal Officers and school teachers will be organized to provide correct information on the competitions. It is very important procedure that Zonal Officers and school teachers understand the objective of the project before the implementation of competition.

(5) Program 5: Improvement of School Infrastructure and Facilities

1) Problems and Rationale

Sri Lanka has attained high enrollment rates and literacy rates in the education system. However, there are still problems with equity in access to quality education. One of the reasons for this lack of equity is the vast difference between schools in regard to infrastructure, facilities and equipment. This is particularly evident in rural and plantation schools and in conflict areas but also many urban schools share the same disadvantage. Type 2 and Type 3 schools, especially those in rural areas, have very limited basic infrastructure and facilities so that students cannot receive quality education.

Educational facilities and equipment are often lacking with minimum essential classroom furniture, such as desks, chairs, and blackboards etc. as well as shortages of equipment for science and mathematics. Type 1C and Type 2 schools often have poor O-Level laboratories or no laboratories at all even though national standards state that they should have these facilities. Even some 1AB schools are not equipped with appropriate laboratory facilities for science especially for completing the A-Level practical requirements.

The problems above form the rationale for improving minimum infrastructure, facilities and equipment in schools to enhance science and mathematics education. These problems need to be addressed for the following reasons:

- Schools without basic infrastructure i.e. many Type 2 and Type 3 schools provide inferior environment for the students attending them.
- The lack of basic infrastructure not only affects teaching and learning but school management as well. Teacher and student morale and performance is affected by poor infrastructure, facilities and equipment.
- Type 1C, Type 2 and Type 3 schools with poor laboratory and library facilities are greatly disadvantaged compared with other schools having these facilities.

- Poor laboratory facilities in 1AB schools disadvantage A-Level science students.

2) Overall Goal

The following are the goal of improvements to national standards level of minimum infrastructure, and facilities in schools:

- The provision of quality basic infrastructure in needy Type 2 and Type 3 schools
- The provision of O-Level science laboratories with minimum equipment and library facilities for Type 1C and Type 2 schools without them and to upgrade their existing laboratories
- The upgrading of A-Level science laboratories in Type 1AB schools

3) Concept of Program and Contents

The concept of the program is to improve infrastructure, and facilities in schools on a priority basis. The program is to be implemented by means of the two projects outlined below:

a) Improvement of Minimum Infrastructure and Facilities of Type 2 and Type 3 Schools

Improving minimum infrastructure and facilities will be a major factor in improving the quality of science and mathematics education. The improvement activity will be implemented through community Educational Kaizen activity promoted with the assistance of Zonal Offices. Good community participation will maximize the project inputs at the school level and minimize the cost of the work.

b) Improvement of Type 1AB and Type 1C Schools for Science and Mathematics Education

SEMP is upgrading selected Type 1C schools to Type 1AB schools by upgrading and building science laboratories. However, many Type 1C schools and some existing Type 1AB still require this upgrading. To enable students attending these schools equal access to the same quality of science and mathematics education as students obtain at the well-equipped Type 1AB schools this upgrading is an urgent matter.

4) Process of Implementation

The two projects will be implemented in parallel. Both projects have short-term and long-term plans. Short-term plans will target schools with urgent needs for improvement. Lists of improvements will be prioritized, planned and costed for both projects. For the minimum infrastructure project, extensive community consultation will take place through the formation of QE circles for facility development before implementation and will also involve Zonal Office cooperation. The works for Type 1AB and Type 1C

improvement project will be put for tender to the private sector.

a) Improvement of minimum infrastructure and facilities for Type 2 and Type 3 schools

Short term improvement plan (2005 – 2007)

- Target schools: 1,000 schools
- Criteria: Type 2 and 3 schools that require urgent improvement.

These 750 schools will be supplemented by 250 schools (SIRUP II) making 1,000 schools altogether.

Long term improvement plan (2008 – 2012)

- Target schools: 2,700 schools
- Criteria: Type 2 and 3 schools that require improvement.

b) Improvement of Type 1AB and 1C Schools for Science and Mathematics Education

Short term improvement plan (2005 – 2007)

- Target 1AB schools: 150 schools
- Criteria: Type 1AB schools with poor A-Level science laboratories
- Target 1C schools: 300 schools
- Criteria: Type 1C schools with urgent needs for science laboratories and libraries

Long term improvement plan (2008 – 2012)

- Target 1AB schools: 250 schools
- Criteria: Type 1AB schools with poor A-Level science laboratories
- Target 1C schools: 800 schools
- Criteria: Type1C schools with needs for upgrading science laboratories and libraries

4.4 Program Profile

The profiles of the formulated programs are summarized and presented in the Main Report.

4.5 Cost, Benefit and Risks

4.5.1 Cost and Finance

The total cost for implementation of the Master Plan is estimated at Rs.19,850 million: Rs.5,035 million for 2005-2007 and Rs.14,815 million for 2008-2012. The cost for each program component is presented in Table 4.1.

- The major cost comes from Program 5: Improvement of School Infrastructure and Facilities with a share of 64.8%, followed by Program 1: Strengthening of Managerial Capabilities of Schools (15.9%) and

Program 2: Promotion of Activity-based and Interactive Teaching and Learning (13.3%).

- The average annual cost is Rs.2,481 million for the entire program period, that is equivalent to 52.2% of the average annual capital expenditure for the general education during 1998-2002 (Rs.4,750 million). The average annual cost is Rs.1,678 million for 2005-2007 and Rs.2,963 million for 2008-2012, which is 35.3%and 62.4% of the capital budget, respectively.
- From the above and considering the economic growth of the country in the future, the cost required for the proposed programs is within the range of the government finance.

Table 4.1 Total Cost of the Proposed Programs

Program		Budget (million Rs.)			
		2005-2007	2008-2012	Total	Share
1	Strengthening managerial capabilities of schools	91	3,063	3,154	(15.9%)
2	Promoting activity-based and interactive teaching and learning	441	2,192	2,633	(13.3%)
3	Upgrading science and mathematics curriculum	55	11	66	(0.3%)
4	Overall promotion of science and mathematics education	133	1,000	1,133	(5.7%)
5	Improving school infrastructure and facilities	4,315	8,549	12,864	(64.8%)
Total		5,035	14,815	19,850	(100.0%)
Average annual budget (Rs. million/year)		1,678	2,963	2,481	

Source: JICA Study Team

4.5.2 Benefits

The proposed programs in the Master Plan aim directly at improving managerial capabilities, quality education in science and mathematics and basic infrastructure and facilities in the education sector. In addition to benefiting the education sector, the programs will have various socio-economic impacts on the entire nation, as summarized below:

(1) Impacts on the Education Sector

Implementation of the proposed programs is expected to have direct and indirect impacts on (i) management and planning, (ii) quality and efficiency, and (iii) access and equity in the education sector.

1) Management and Planning

Implementation of Educational Kaizen activities at schools will strengthen capabilities of management and planning in MOE, NIE, Zonal Offices and schools. Since schools prepare their development plans based on their own priorities, a mismatch of schools' needs and those supplied by MOE will be

eliminated. In addition, the improvement in managerial capabilities will lead to reduction of administrative costs by introducing a school information management system.

2) Quality and Efficiency

The Pilot Project has proved that Educational Kaizen activities can change the school culture. This change will lead to challenging activity based and interactive teaching and learning methods, that will stimulate students' interests in science and mathematics and eventually academic achievement level will be improved. Furthermore, teachers will develop teaching materials considering the real needs of their students. This will make the teaching and learning process more efficient.

Moreover, because of the provision of quality education in science and mathematics, the number of students proceeding to the science stream will increase. This fills the vacancies in the A-Level science stream.

3) Access and Equity

The Pilot Project has proved that the change in school culture made the students' attendance rate increase. In addition, the Pilot Project has also shown that parents' participation in school activities increased through Educational Kaizen activities and the costs of development, rehabilitation and maintenance decreased quite considerably. This was particularly effective in poorly equipped rural schools. Furthermore, the collaborative activities among the pilot schools observed in the Pilot Project provided opportunities for academic leveling among the schools. All this evidence indicates that Educational Kaizen activities contributed to the improvement of the equity.

Through the implementation of the above, the goal of the Master Plan will be achieved. The proposed programs will also contribute to cost reduction in the education sector, enabling efficient budget allocation and use.

(2) Impact on Socio-economy

The various impacts on the socio-economy are also expected from implementing the proposed programs.

1) Activation of community and society

The proposed programs will assist students in acquiring competencies of problem identification and problem solving through participation in Educational Kaizen activities. Active participation of parents and community in school activities will enable the schools to be a community development center. Likewise, Educational Kaizen activities will expand from the schools to students, parents, community and society. Through these, the proposed programs will stimulate people to make the society more active, efficient and dynamic.

2) Development of competency based human resources

The proposed programs will enhance quality education in science and mathematics. This will help students learn how to apply theories and knowledge of science and mathematics to their daily life, which will provide them with capabilities of self-learning and self-improvement. The industrial sector requires these human resources, who can develop their skills to match changing technologies.

Knowledge of science and mathematics is a powerful tool not only for engineers and scientists, but for the entire society. High quality education in both subjects will enable the society to be effective and productive, which will make the country competitive in the global market.

4.5.3 Risks

Under the assumption that the present peace situation will continue and improve in future, there exist following risks to be considered in implementing the proposed programs:

- Policy change in MOE against the introduction of Educational Kaizen activities, which may come from opposition by the teachers' unions.
- Delay of the devolution process from MOE to Provincial Departments, Zonal Offices and schools.
- Movement against the Educational Kaizen activities, which may occur if inadequate budget use is discovered at schools due to insufficient administrative preparation prior to introduction of the proposed programs.

4.6 Action Plan and Implementation Arrangement

4.6.1 Action Plan

In the Master Plan, implementation of Educational Kaizen activities at the school level is taken as the key strategy for improving of science and mathematics education, and its expansion to all government schools in the country is proposed. In due consideration of the fact that keeping current momentum and expansion of the Educational Kaizen activities are important and indispensable for attaining the improvement of the sub-sector, the Action Plan is formulated for realizing the short-term target, namely, expansion of the Educational Kaizen activities up to 500 schools. For accomplishing this, the most urgent and high priority projects are identified and selected from 18 projects proposed in the Master Plan, which need to be implemented immediately during 2005-2007.

Projects for the Action Plan are selected using the following criteria:

- Institutional support projects which need to be implemented before other programs and projects, because they will constitute the foundation for other programs and projects. (such as organizational set-up, institutional strengthening, and training)
- School-based projects which can be implemented immediately at the school level, because it does not require big investments from outside.
- School-based projects which are a logical extension of JICA Pilot Project.
- Projects which need to be implemented together due to their interrelated nature.

Based on these criteria, the following 8 projects are selected as the proposed projects for the Action Plan:

Project 1.1:

Establishment of Institutional Framework for Educational Kaizen Activities

Project 1.2:

Institutional Strengthening of MOE and PEA for Educational Kaizen Activities

Project 1.4:

Establishment of School Framework for Educational Kaizen Activities

Project 1.5:

Strengthening of School Information Management System

Project 2.1:

Institutional Support for Activity-based and Interactive Teaching and Learning

Project 2.2:

Training of Science and Mathematics Teachers on Activity-based and Interactive Teaching and Learning

Project 2.3:

Enhancement of Professionalism of Mathematics and Science Teachers

Project 2.4:

School-based Promotion of Activity-based and Interactive Teaching and Learning

While some of the above projects cover not only 2005-2007 but also 2008-2012, only 2005-2007 components are included as the Action Plan. The relationship and order of implementation among these programs and projects are illustrated in Figure 4.6.

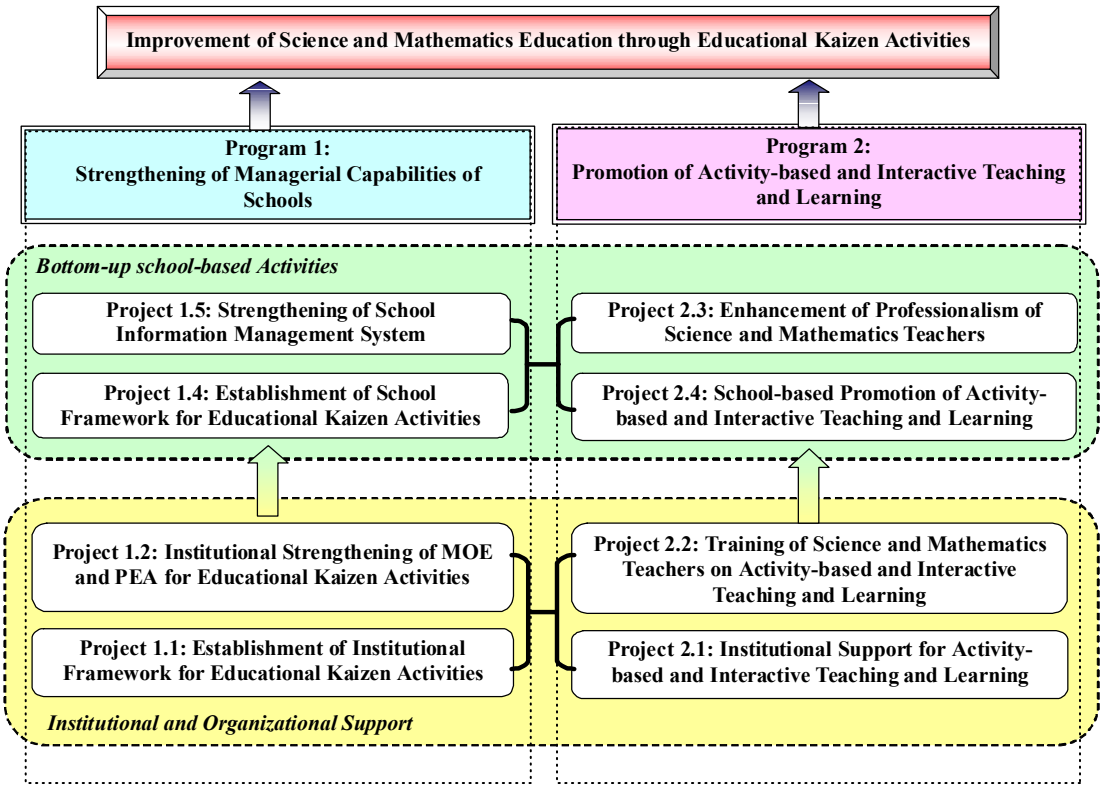


Figure 4.6 Programs and Projects in the Action Plan (2005-2007)

4.6.2 Implementation Organization

Implementation Organization for the Action Plan is described in Figure 4.7.

Key characteristic of this implementation organization is establishment of the following two new units in MOE and NIE in order to implement the Action Plan:

- MOE's Educational Kaizen Unit
- NIE's Unit for Activity-based and Interactive Teaching and Learning.

MOE's Educational Kaizen Unit will be established under Planning Division of MOE, and will be in charge of formulation of annual implementation and financial plans of the Unit, implementation and coordination of Educational Kaizen activities at the national level, coordination with Provincial Department of Education, collaboration with NIE Unit, and supervision, monitoring and evaluation of ZEIKA through Provincial Offices. MOE will appoint necessary staff to Educational Kaizen Unit, but the following staff is recommended:

- Head of Unit (Director of Education)
- 3 Officers (Assistant Director of Education)
- 1 Assistant Staff
- 1 Secretary

NIE's Unit for Activity-based and Interactive Teaching and Learning will be established under the Faculty of Science and Technology, and will be in charge of development of teaching materials and training of ISAs and A-Level master teachers on activity-based and interactive teaching and learning. This Unit will be equipped with multimedia and necessary training. NIE will appoint necessary staff to the Unit, but the following staff is recommended:

- Head of Unit
- 5-10 Officers/Trainers
- 2 Secretaries

For promotion of Educational Kaizen activities, the following three-tiered organizations will be established:

- National Education Initiative of Kaizen Activities (NEIKA) at the national level,
- Zonal Education Initiative of Kaizen Activities (ZEIKA) at the zonal level and
- School Education Initiative of Kaizen Activities (SEIKA) at the school level.

A new NEIKA will be established after review of the current organization and function, under Additional Secretary (Planning and Performance Review) of MOE as a national level supervisory committee to formulate policy guidelines on Educational Kaizen activities, monitor the nation-wide progress of Educational Kaizen activities and provide necessary advice for MOE's Educational Kaizen Unit.

In addition, ZEIKA will be established under the Zonal Director of Education in the pilot zones, where the Educational Kaizen activities will be conducted, as the zonal level advisory committee to monitor the zone level progress of Educational Kaizen activities and provide necessary advice for Zonal Director of Education.

Unlike NEIKA and ZEIKA, SEIKA will be a decision making and executing body responsible for Educational Kaizen activities at the school level. SEIKA will be established in the pilot schools, where the Educational Kaizen activities will be conducted. It will formulate a school development plan, secure budget, and conduct internal monitoring of QE circles. SEIKA members will be appointed at a meeting of School Development Society, and consist of around 10 to 15 people.

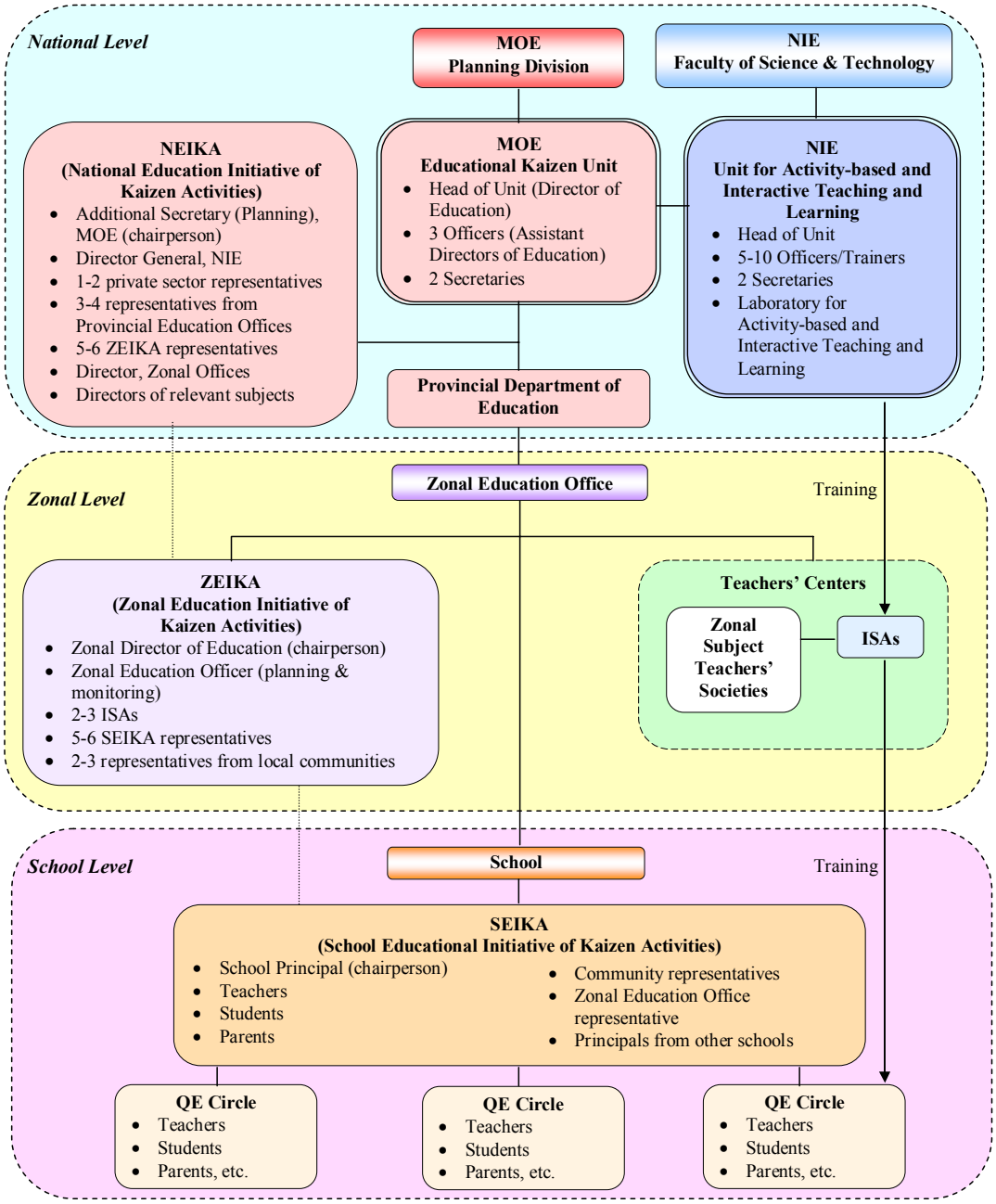


Figure 4.7 Implementation Organization for the Action Plan

4.6.3 Implementation Schedule and Cost

The Action Plan is planned to be implemented during the period of 2005-2007 as shown in Table 4.2. The total cost for the Action Plan is estimated at Rs.300.2 million.

Table 4.2 Implementation Schedule and Cost of the Action Plan

Project	Executing Agency	2005	2006	2007	Estimated Cost (Rs. million)
Project 1.1: Preparation of Institutional Framework for Educational Kaizen Activities	MOE				2.6
Project 1.2: Institutional Strengthening of MOE and PEA for Educational Kaizen Activities	MOE ZEIKA				11.7
Project 1.4: Establishment of Framework for Educational Kaizen Activities	MOE NIE Schools				75.9
Project 1.5: Strengthening of School Information Management System	Schools				7.7
Project 2.1: Institutional Support for Activity-based and Interactive Teaching and Learning	MOE NIE				25.0
Project 2.2: Training Science and Mathematics Teachers on Activity-based and Interactive Teaching and Learning	MOE NIE				104.0
Project 2.3: Enhancement of Professionalism of Mathematics and Science Teachers	MOE				68.1
Project 2.4: School-based Promotion of Activity-based and Interactive Teaching and Learning	MOE Schools				5.2
Total Cost for the Action Plan					**300.2**

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

5.1.1 Pilot Project

School-based approach or Educational Kaizen activities are applied at the selected 25 schools island wide as the Pilot Project during 2003-2004. In the Pilot Project, 118 QE circles were formulated in which 944 activities were taken up for promoting the improvement. These activities are, in principle, classified into three categories, namely, "School Management", "Science and Mathematics Education" and "Basic Infrastructure and Facility" that are the three main target fields for the improvement in this study.

After one year implementation, results and impacts of the Pilot Project are evaluated through the monitoring and Post Pilot Survey (PPS) as summarized below.

a) The school-based approach applied in the Pilot Project is quite effective and efficient to improve school management as indicated in "Parents' Satisfaction with School" or "Parent's Support" of the Questionnaire Survey (QS). Through the introduction of various improvement activities, motivation of principals and teachers changed that finally led to change even the school culture.

b) Through the implementation, it is recognized that the activated school culture is the foundation of any improvement without which any bottom up approaches could not work well. In the Pilot Project, substantial increases in student attendance were recorded as one of the indicators of the change in school culture.

c) Science and mathematics education has been facilitated through applying activity-based teaching and learning method using model experiments and creative teaching materials prepared by teachers. Actually, results of Academic Ability Test (AAT) on science and mathematics showed that the students of the pilot schools got higher marks for two subjects than that of non-pilot schools, and application of the school-based approach is quite efficient for science and mathematics education.

d) Basic infrastructure and school facilities were also improved through the school-based activities. These activities were further promoted by the

participation of parents and community people that reduced the required cost for the improvement substantially, by 30-40% or more.

e) Through the Pilot Project, it is recognized that the Educational Kaizen activities gave much impacts on non-urban schools than on urban schools, that indicates the school-based approach contributes not only to quality of education, but also to improving inequity among schools.

Various lessons are provided after one year implementation of the Pilot Project, major of which are summarized below.

- Educational Kaizen approach can be applicable to the education sector.
- Improvement of school culture is fundamental for which good communication among them is the key factor.
- Important factors of the successful school-based approach are:
  - facilitative leadership of principals;
  - open discussion among representatives and transparency in the process of decision-making; and
  - maintenance of records of meeting.

5.1.2 Master Plan

The Master Plan has been formulated after implementing the Pilot Project by fully incorporating the valuable experience and lessons. The strategies applied to the formulation of the Master Plan are:

- A school-based approach or Educational Kaizen activities applied in the Pilot Project and proved effective for improvement are first used as key strategy for formulating the plan.
- Then, institutional and organizational support, or top-down approach is planned for facilitating the school-based approach as a supplemental one.
- Overall improvement for science and mathematics education through enhancement of the awareness of the importance of the two subjects is taken up for the plan formulation.
- Preparation of practical and implementable plans is another key strategy through concentrating on promotion of activities and intensive involvement of counterpart personnel.

Applying the above strategies, various improvement projects are formulated in the short term (2005-2007) and long term (2008-2012), which are classified into the following five program groups:

Program 1: Strengthening of Managerial Capabilities of Schools
- Three (3) projects of top-down approach
- Three (3) projects of school-based approach

Program 2: Promotion of Activity-based and Interactive Teaching and Learning

- Three (3) projects of top-down approach
- Two (2) projects of school-based approach

Program 3: Upgrading Science and Mathematics Curriculum Focusing on Syllabus and Teachers Guides

- Two (2) projects of Top-down approach

Program 4: Overall Promotion of Science and Mathematics Education

- Three (3) projects of Top-down approach

Program 5: Improvement of School Infrastructure and Facilities

- One (1) project of Top-down approach
- One (1) project of School-based approach

Total cost of implementing the projects for the Master Plan is estimated at Rs.19,850 million, which are divided into Rs.5,035 million for 2005-2007 and Rs.14,815 million for 2008-2012.

The Action Plan is formulated that includes necessary projects to realize implementation of the Educational Kaizen activities in 500 schools or attaining the short term target of the Master Plan. Eight projects from the Program 1 and 2 are selected as the Action Plan. The implementation arrangement of the Action Plan including formation of implementing organization and scheduling is also prepared for early materialization.

5.2 Recommendations

For promoting Educational Kaizen activities and successfully implementing the proposed projects, it is recommended that the following preparation and arrangement are made by MOE in close collaboration with NIE and the related organizations.

1) Authorize the Master Plan and Prepare for Implementation

   First, MOE and NIE are to authorize the Master Plan confirming the policy of promoting the school-based activities for quality improvement of the education and publicize them to all the government agencies concerned. Necessary arrangement for implementing the Action Plan including financial allocation is to be commenced at the earliest stage.

2) Establish New Units in MOE and NIE

   For promoting Educational Kaizen activities and activity-based and interactive teaching and learning, new units are to be established in MOE and NIE. The units are to be equipped with sufficient number of experienced staff and to function as the promotion center providing necessary information and monitoring services through their local offices.

3) Promote Awareness of Educational Kaizen Activities in MOE/NIE

Understanding on the importance of the school-based approach for development of education, particularly on science and mathematics is still not sufficient both in MOE and NIE. Awareness campaign is to be implemented for promoting the activities by the initiative of the Counterpart personnel of the JICA Study Team using the video and other promotional materials. Study tour to the pilot schools where Educational Kaizen activities have been carried out is also to be planned inviting top management and staff related.

4) Use the Models/Products Prepared through the JICA Study effectively

Various kinds of materials for implementing activity-based and interactive teaching and learning are prepared including model experiments, teaching aids, 100-box calculation, etc. which are proved to be quite effective for quality education. These materials are to be used more intensively in the teachers' training in NIE and distributed to schools for facilitating the school-based activities.

5) Deploy Required Number of Teachers and Enforce Equitable Deployment Policy

Number of teachers is not sufficient and those for science and mathematics are in acute shortage, particularly in rural areas. Deployment of necessary science and mathematics teachers is to be implemented to fill the gap as soon as possible. Strict application of the deployment policy on teachers is also to be enforced to avoid political intervention on the deployment and personal excuse of escaping assignment in rural areas. Additional financial incentives for teachers working in rural schools are to be devised.

6) Intensify Follow-up of Training on Principals and Teachers

Various in-service trainings have been conducted for principals, ISAs and teachers in NIE. However, the effects or impacts for them are quite limited due to lack of follow-up works. It is, therefore, strongly recommended that regular monitoring and follow-up be conducted in order to ensure the actual implementation of what was trained at the local and school levels. Evaluation of the performance on the basis of the monitoring would be more effective method for enhancing the effects of the training.

7) Enhance Coordination among Stakeholders

Lack of coordination has been the common fault of not only the education sector, but other sectors in the country. Nevertheless, there is a strong need of open dialogues and sharing consensus among stakeholders when introducing and implementing new attempts such as Educational Kaizen activities. As the workshop on SBM held in August, 2004 sponsored by MOE with cooperation of JICA Study Team contributes to deepen understanding of the concept of SBM and on-going projects of different donors. Coordination among

stakeholders is further to be enhanced by initiatives of MOE and NIE for the successful implementation of the Master Plan. Necessary fund arrangement for the implementation of the Master Plan is also to be processed under the well coordinated framework of stakeholders.